

Compressed Air

NOVEMBER 1956

Magazine

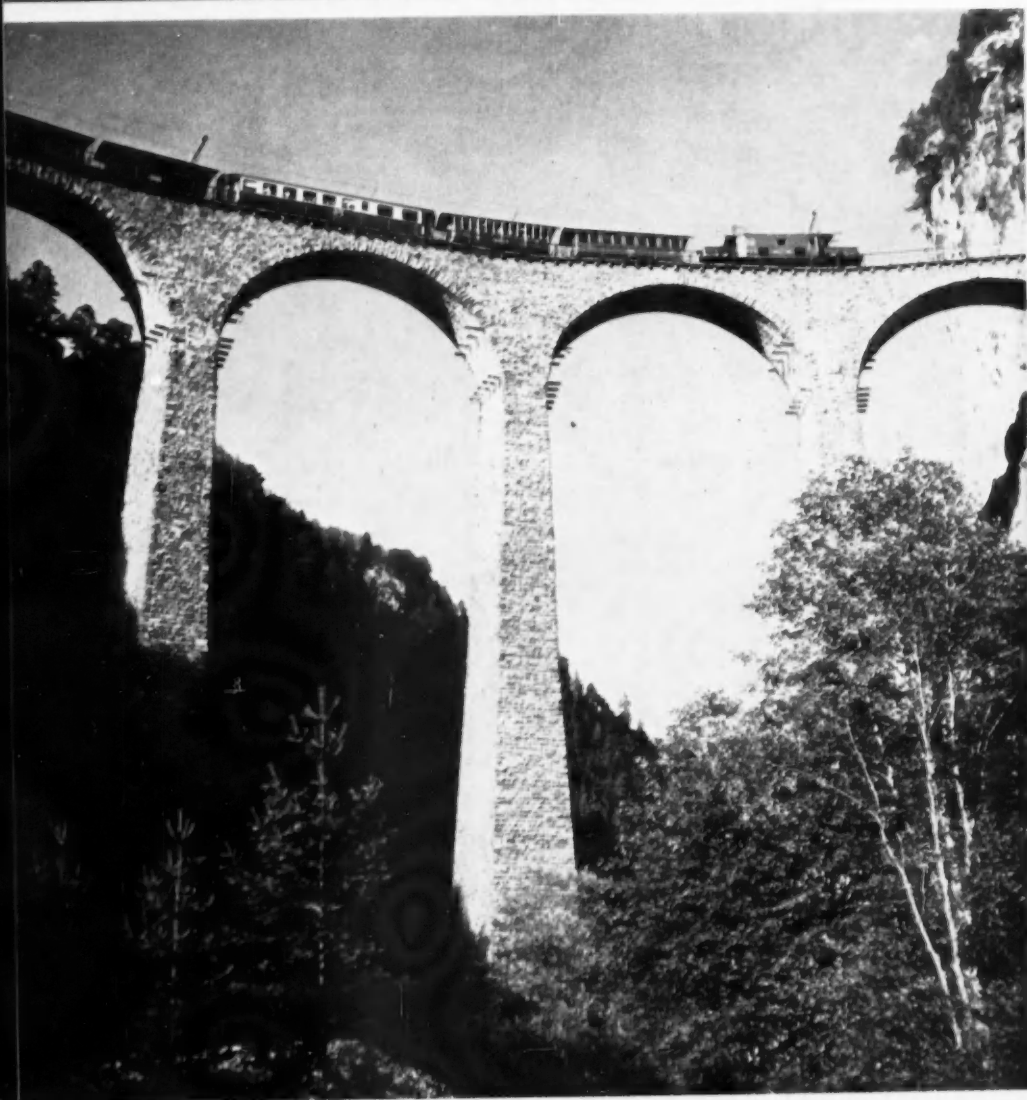


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•
SWISS RAILROAD
REACHES FOR SKY
Trains cross Albula Valley
on masonry viaduct of
beautiful design
SEE INDEX PAGE
•

VOLUME 61 • NUMBER 11

NEW YORK • LONDON

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With the complete line of I-R paving breakers, you can select a tool that's *right* for every job—right in weight, breaking power and ease of handling and with the right I-R accessories too.

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Dollinger makes ALL TYPES of filters as shown on this page, plus special filters for unusual filtration problems. New users of one specific type of Staynew filters often find a second Dollinger filter performs a great, added service in other processes or operations. Perhaps we can serve major or other filtration needs of your plant.

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Model HE (Sump)
Liquid Filter
Bulletin 330



Model ELS (Pressure)
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Bulletin 300

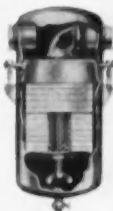
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Pipe Line Filter
Bulletin 200



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Pipe Line Filter
Bulletin 200



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Pipe Line Filter
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Bulletin 200

all types of FILTERS for
every INDUSTRIAL NEED

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Model C (Indoor)
Air Intake Filter
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Automatic
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Bulletin 500



Dry and
Viscous Panel
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Write, using Bulletin Numbers, for complete information on any of the Staynew filters illustrated. Consult Dollinger engineers on any special filtration problems—no obligation. Dept. 7 Centre Park, Rochester.

LIQUID FILTERS, PIPELINE FILTERS, INTAKE FILTERS, HYDRAULIC FILTERS, ELECTROSTATIC FILTERS, DRY PANEL FILTERS, VISCOUS PANEL FILTERS, LOW PRESSURE FILTERS, HIGH PRESSURE FILTERS, AUTOMATIC VENTILATION FILTERS, NATURAL GAS FILTERS, SPECIAL DESIGN FILTERS, SILENCER FILTERS



Tacoma City Light Photo

NEW DAM UNDER WAY IN LAND OF LEWIS AND CLARK — Shown high above the Cowlitz River, near Mayfield, Wash., these workmen are making blast holes with 1-in. hexagon and 1½-in. round Bethlehem Hollow Drill Steel, to prepare the cliff face for construction of an abutment for Tacoma City Light's Mayfield Dam. The concrete-arch dam is part of a \$138,100,000 hydroelectric project for City of Tacoma. It will have gravity wings and thrust blocks, and upon completion will be 185 ft high and 850 ft long. Its spillway section will be 205 ft wide.

Contractors: Arundel Corporation and L. E. Dixon Co. Tunnel subcontractor: Gibson & Roberts, Inc. Drill steel reconditioning: Senter Tool Service.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM HOLLOW DRILL STEEL





Powerful crowding action fills this big, half-yard capacity bucket in any muck pile. Fast discharge and near-perfect clean-up at the face are time-saving abilities of the Eimco 630.

An Eimco 630 "moves in" for another load, operated by easy-to-reach, easy-to-work controls.



The Eimco 630 Crawler-Excavator is gaining more respect for its adeptness in a greater variety of underground mucking tasks by responding favorably to new tests of its versatility.

One recent field report points to an Eimco 630 Transport-Loader that has been loading rounds much faster and getting better "clean-outs" during five months of competition with a 48" box scraper with a 50 h.p. slusher.

Near-perfect clean-out by the 630 increases drilling efficiency. To get 630 clean-out results in a slusher operation, requires use of snatch blocks along the foot and hanging walls and final clean-up at the face thru hand shoveling.

So outstanding has been the Eimco 630's performance, future stopes are being planned for maximum utilization of its many operating advantages.

The 630 Transport-Loader with integral, automatic discharge, 30 cu. ft. hopper, is very profitably in use for short hauls and floor-level dumping in a wide variety of industries.

And—like all 630 excavator-dozers units, the transport loader has that extra maneuverability thru independent track operation—control simplicity and the big, half-yard bucket capacity.

BEFORE YOU DECIDE ON A MINING PATTERN, investigate the EIMCO 630. You'll find—as others have—it pays to plan your mining strategy around operating advantages of the versatile 630.

THE EIMCO CORPORATION

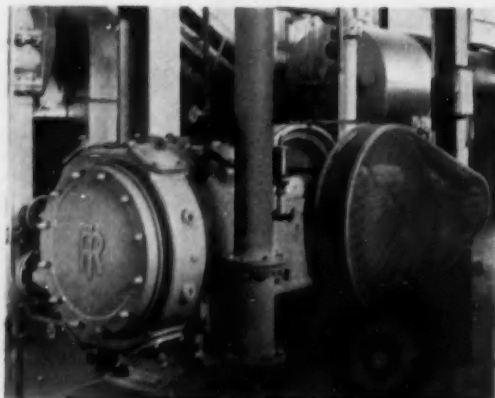
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EVACUATE

✓ Continuously ✓ Dependably ✓ Economically



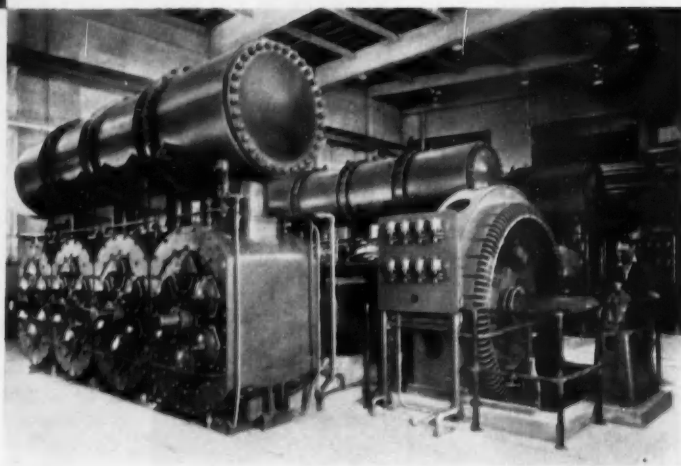
Ingersoll-Rand two-stage ES vacuum pump serving evaporators in a large salt company plant. These horizontal, heavy-duty, single-cylinder units are available in piston displacements of 114 to 3140 cfm, for vacuums down to 29.2" Hg single-stage and 29.8" Hg two-stage.

Each one of three 2000-hp Ingersoll-Rand HHE vacuum pumps has a piston displacement of 51,508 cfm. These units exhaust air from large test chambers used to simulate high altitude conditions.

WITH
HEAVY-DUTY  VACUUM PUMPS

*...now available in sizes from
7½ hp to 2000 hp,
for vacuums down to 29.8" Hg*

(Air-cooled units . . . ½ to 7½ hp)



Ingersoll-Rand reciprocating dry vacuum pumps are designed and built to give dependable performance under any or all of the following conditions:

1. Wherever continuous heavy-duty, full-load service is essential.
2. Where power cost is an important factor.
3. In plants where supervision is limited.
4. Where low over-all operating costs must be maintained.

The wide range of standard sizes, with flexibility of cylinder design and choice of electric, steam or gas-engine drive, makes these heavy-duty units

adaptable to practically all vacuum requirements for handling clean, dry air or gases. Cylinders are normally equipped with I-R Channel Valves—known the world over for quiet, efficient operation and remarkable freedom from maintenance.

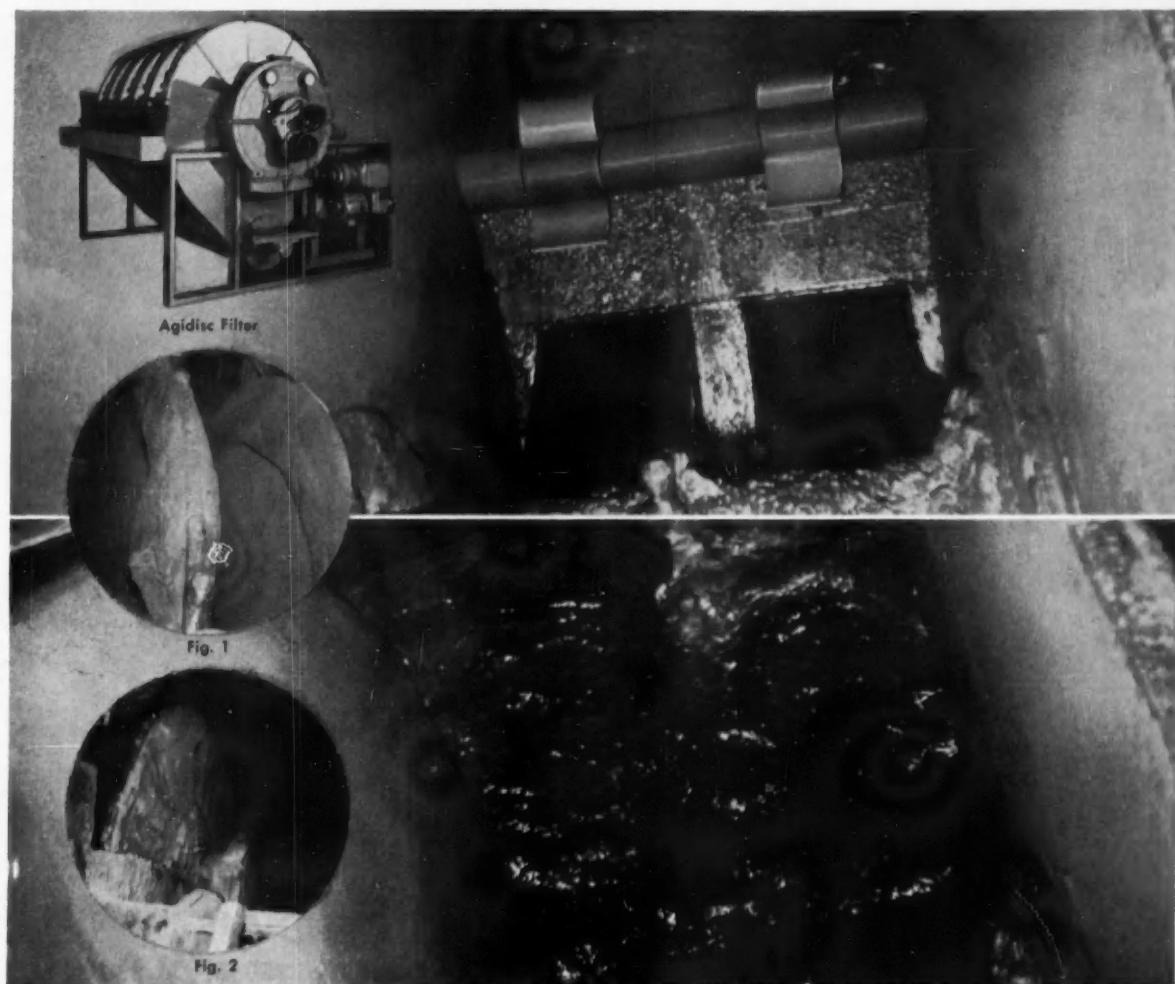
Ingersoll-Rand also builds a full line of steam jet ejectors. I-R engineers can select the reciprocating or centrifugal pump, or steam-jet ejector, or combination of these that will give the most economical vacuum production for any capacity requirement.

Your I-R representative will be glad to give you complete information on the vacuum equipment best suited to your needs.

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COMPRESSORS • GAS AND DIESEL ENGINES • ROCK DRILLS • PUMPS • TURBO-BLOWERS • AIR AND ELECTRIC TOOLS



THE EIMCO AGIDISC FILTER GETS UNIFORM RESULTS

The Eimco Agidisc is the only disc type filter with proven ability to get uniform cake formation from all fast settling solids.

A veteran superintendent of a concentrator, processing complex metallurgical slurry says, "The Eimco Agidisc is the one really effective means to get uniform particle suspension in disc filter tanks."

This magnetite pelletizing plant uses five 6 X 6 Eimco Agidiscs. Each filter is capable of processing 640 long tons of concentrate per 24 hour day. The feed contains 63% solids at 62% minus 325 mesh. Specific gravity is 5.0. The filter cake has 7.5% moisture.

Experience has taught filter station personnel that **uniformity** is the key to good operating results when fast settling particles are in the feed. Only the Eimco Agidisc Filter gives strong, properly directed agitation.

Insufficient agitation results in a classification ring on the periphery of the disc with thin, slimy cakes near the center. Disadvantages here are high cake moisture and low capacity. (See Fig. 1).

If agitation is too violent, the result is a scouring action on the periphery of the disc. Disadvantage here is principally low capacity. (See Fig. 2).

The Eimco Agidisc eliminates both of these costly formations as shown in figure 3. (One disc is removed to show construction). A variable speed reducer promotes proper surface movement. The Eimco gets **uniform** cake dryness; **uniform** cake thickness; **uniform** particle dispersion and **uniform** tonnage consistent with feed.

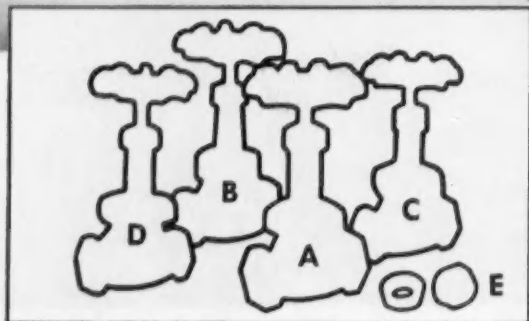
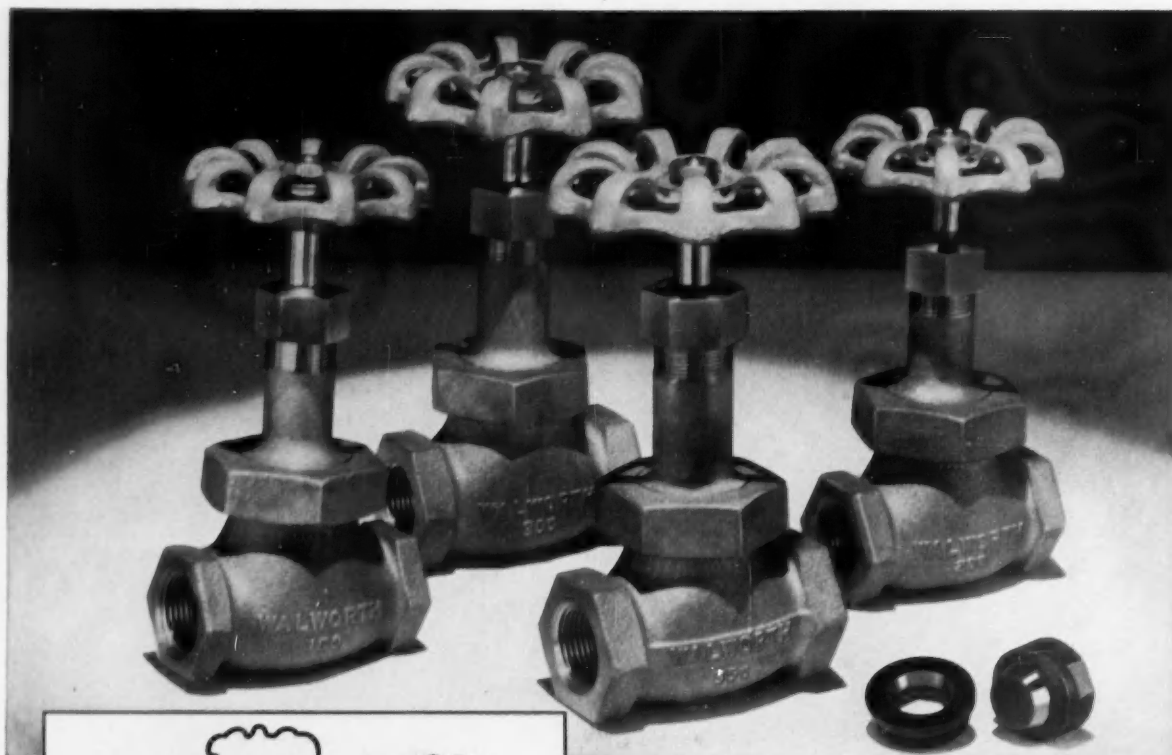
The Eimco Agidisc can help your operation by increasing tonnage and lowering moisture content in the cake. Write for complete information today!

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B-221



- A—No. 225P.....350 WSP 550F, 1000 WOG
- B—No. 260P.....300 WSP 550F, 600 WOG
- C—No. 245P.....200 WSP 550F, 400 WOG
- D—No. 237P.....150 WSP 500F, 300 WOG
- E—"500 Brinell" Stainless Steel Plug Type Seat and Disc

Walworth offers four lines of Bronze Globe Valves with stainless steel, plug-type seats and discs. Advantages of these valves include:

- **Stainless Steel Plug-Type Seats and Discs**, heat-treated to a minimum of 500 Brinell hardness reduces wire-drawing to a minimum. Seats and Discs are machined and fitted simultaneously, assuring perfect mating.
- **Deep Stuffing Boxes with Glands** are fitted with reinforced, molded packing. Valves can be repacked under pressure when fully opened.

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"500 BRINELL" PLUG-TYPE STAINLESS STEEL SEATS AND DISCS

150 lb. 200 lb. 300 lb. 350 lb.

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- **Rugged Body Hexes**, are flat on top; do not interfere with wrench gripping body-to-bonnet union ring connection.
- **Bodies**, made of Composition M bronze (ASTM B61), have ample wall thickness to provide high safety factor.
- **Patented Handwheels** are air-cooled and designed with a "finger-fit grip." Makes turning easy even when wearing greasy gloves.
- **Identification Plates** secured by lock-washer under stem nut, show Figure Number of valves and make re-ordering sure and easy.

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EIMCO 105 -- MORE POWER FOR MORE WORK

Eimco 105 Tractor-Excavators are balanced to give maximum work efficiency in every phase of digging and loading. Compare these figures—(A) 39,200 pounds of digging force at the bucket lip as the 105 moves into the rock pile; (B) 39,200

pounds of lifting capacity for break-out power.

This power gives the operator the same potential in productive capacity as he would have if you bought him a boom type shovel costing three to four times as much.

How does Eimco design a small (1½ yard) Tractor-Excavator to out-produce every other machine in its price range?

The answer to this is Eimco's unique Tractor design which provides better balance, lower center of gravity and delivers full engine horsepower to the bucket at all times.

Eimco also makes it easier to operate the 105 Tractor-Excavator. The operator sits up front where he can see what he is doing. Two small handles, easily held in one hand, control all movements of the

Tractor. The operator does more work with less effort, stays efficient the entire shift.

Other firsts in the Eimco 105 Tractor-Excavator include (1) independent track control so that one track can be run forward while the other turns reverse; (2) separate final drives for each track; (3) full track oscillation on the tractor when equipped with loading or excavating attachment; (4) elimination of master clutch and drag-track steering; (5) Unidrive transmission in which gearing always rotates in the same direction; (6) all alloy steel construction; (7) clutches that never need adjustment — and many other exclusive features.

See these completely new tractors as Bulldozers, Excavators or Loaders working near you. Write for complete information.



THE EIMCO CORPORATION

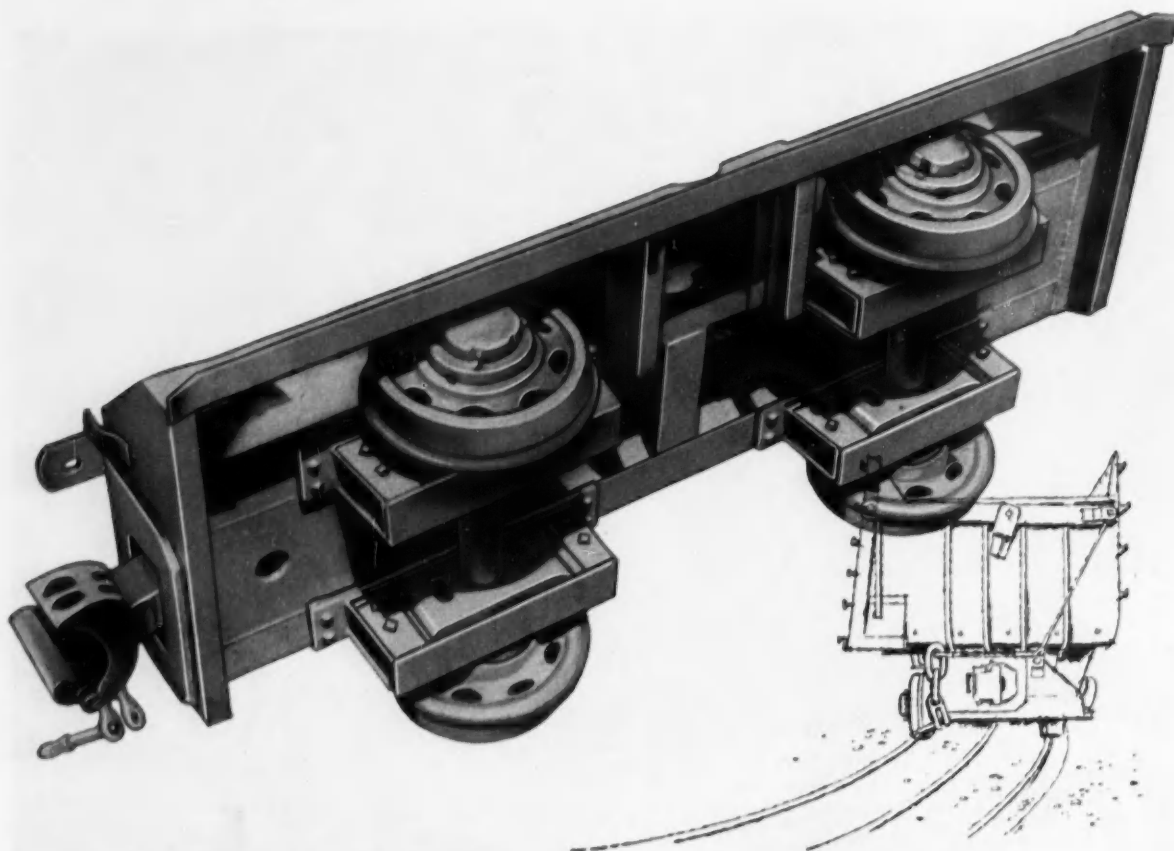
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B-222



for extra strength
it's CRUCIBLE **MAX-EL** alloy steel

Mine car axles *always* take a beating. But where service is *especially* rugged, manufacturers — like C. S. Card Iron Works, Denver, Colorado — use Crucible Max-el 3 1/2 alloy steel.

In their own words, here's why . . .

"We use Max-el 3 1/2 because of its high-strength . . . good fatigue resistance . . . and over-all economy."

Good reasons why Max-el, or another of Crucible's wide range of special alloy steels, may be the right answer to many of your more exacting applications. Your local Crucible representative will be glad to give you more details.

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CRUCIBLE

first name in special purpose steels

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"Used many makes of turbines... PREFERS COPPUS"

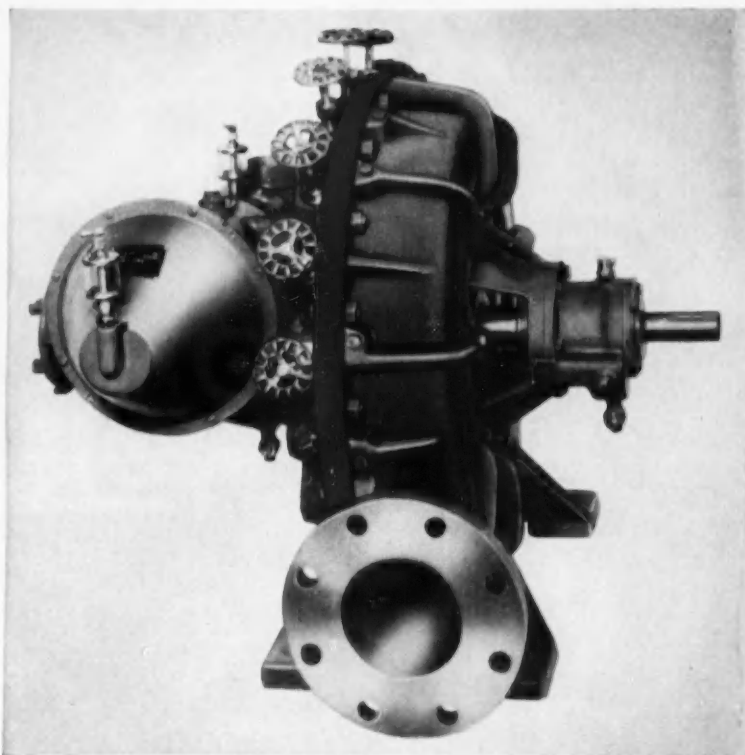
If you want to know about turbine performance, ask an *operator*. He *knows*. And, in the words of one of them:

"I have had occasion in the past to operate many makes of turbines. The plant in which I am now employed is almost entirely Coppus equipped on our auxiliary equipment. I find your turbines most satisfactory and would like to congratulate you on your design."

Whether you use a Coppus with a regular wheel or wide bucket "L" type you get these *proven* features:

- Turbines rated close to your hp requirements from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.
- Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbine.

COPPUS ENGINEERING CORPORATION
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This is the reliable Coppus Turbine furnished with either a regular wheel or wide bucket "L" type wheel.

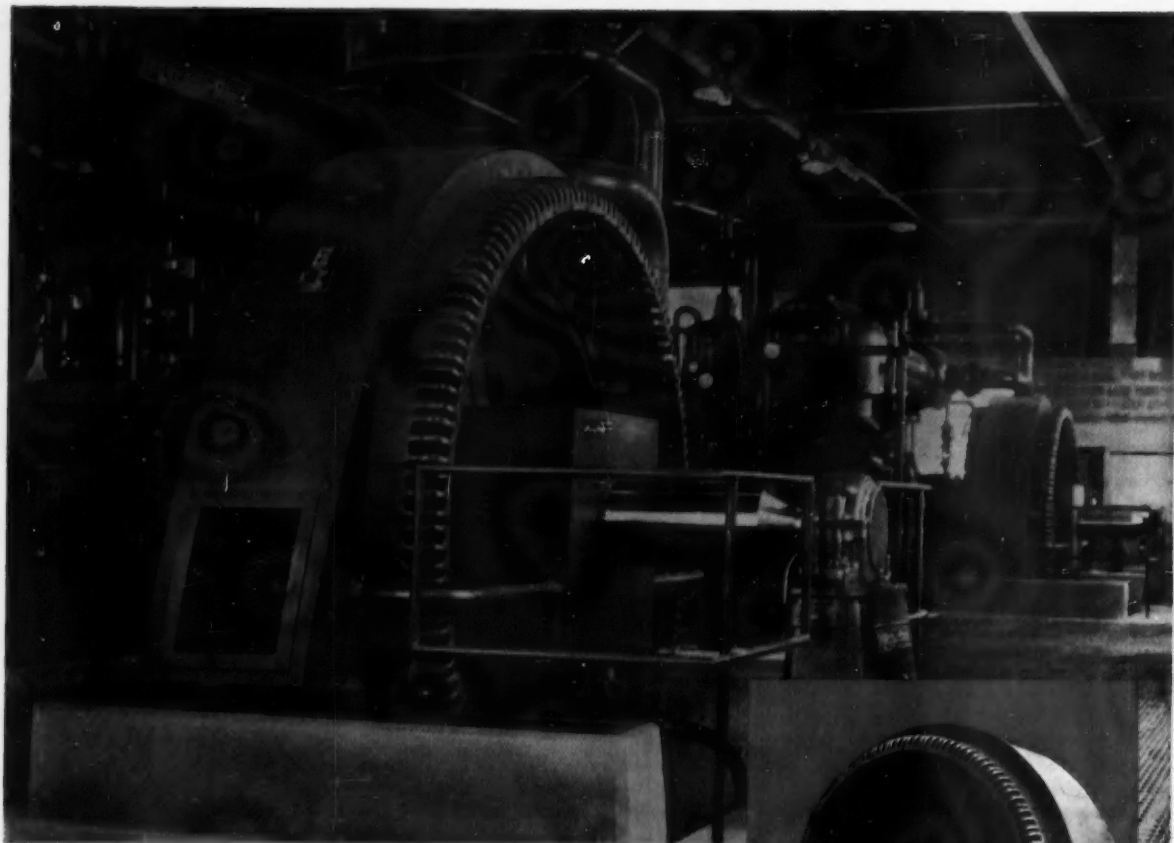


This wide bucket "L" type wheel is a new development for use where low water rate is essential



This is the regular wheel used on Coppus Turbines which have been so highly satisfactory throughout industry.

COPPUS "BLUE RIBBON" TURBINES

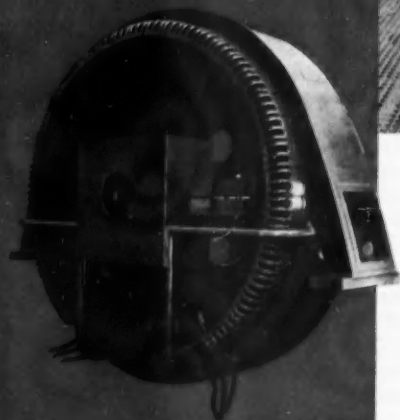


Large Elliott Motors power unique compressor installation

In a New England chemical plant, two 3500-hp, 300-rpm Elliott synchronous motors furnish the power to drive compressors which are the heart of an ammonia process. The unique feature of the installation is that the compressors each provide *four* services, one more than has ever been attempted before.

The motors are started across the line, being brought up to speed and field-applied in four to five seconds with a minimum of disturbance to the system voltage and a momentary frequency drop of less than 0.5 cycle. An Elliott 7500-kw turbine-generator, operating as an isolated unit, is used for starting.

Elliott offers broad experience in many fields of motor applications to assist users in achieving greatest economy and dependability of service. Consult the nearest Elliott District Office, or write Elliott Company, Ridgway Division, Ridgway, Pa.



Built to stand up on the toughest jobs

The rigid Fabritrol construction, unequalled insulation protection and other features of Elliott large motors give them the stamina to withstand the most severe service. The motor shown above is one of those installed in the plant illustrated in the photograph at the top of the page. Its rugged construction is apparent.

ELLIOTT Company

RG-18



STEAM TURBINES • MOTORS • GENERATORS
• DEAERATING HEATERS • EJECTORS • CONDENSERS •
CENTRIFUGAL COMPRESSORS • TURBOCHARGERS
• TUBE CLEANERS • STRAINERS

ON THE COVER

THE terrain of Switzerland is such that almost any train you board there will take you on an alpine scenic tour. Our cover picture depicts a masonry viaduct of slender and graceful lines carrying a train across Albula Valley. Out of view at the right the rails enter a tunnel. This link of the Swiss Federal Railways is called the Rhaetian line and crosses Albula Pass at an elevation of approximately 5900 feet. The pass has been the principal route between the Engadine and Grisons regions of Switzerland since the thirteenth century. The railway was opened in 1903.

IN THIS ISSUE

WITHOUT threaded fasteners, the mechanical world would literally fall apart. They are vitally needed wherever metal, wood or plastic members are joined. The annual output of products made on screw machines is valued at \$485 million. Around 1000 assorted bolts and nuts are required to assemble one automobile, and the automotive industry as a whole used more than ten billion fasteners last year. Sales of high-tensile bolts, relative newcomers to the fasteners group, are gaining more rapidly than those of any other item. Our leading article takes a general look at the threaded-fasteners industry.

WHEREVER Walt Disney is, there is artistry. The latest product of his facile mind is Disneyland, Southern California's fabulous creation of realism and make-believe where you can project yourself into the past or the future and be entertained while you are doing it. Page 333.

IT IS generally believed that the peak of turnpike construction has been passed. That began to be apparent a year or two ago when the most urgently needed toll roads had been built or put under construction. Since the Government's multibillion-dollar program for free highways was announced, turnpike talk has further subsided. Meanwhile, contractors are putting the finishing touches on the 110-mile Northeastern Extension of the Pennsylvania Turnpike, first of the modern pay-as-you-ride thoroughfares. The grading of the right of way for its northern section through successive ridges of the Appalachian uplift was a big and interesting job of earth and rock moving. Page 336.

Compressed Air Magazine

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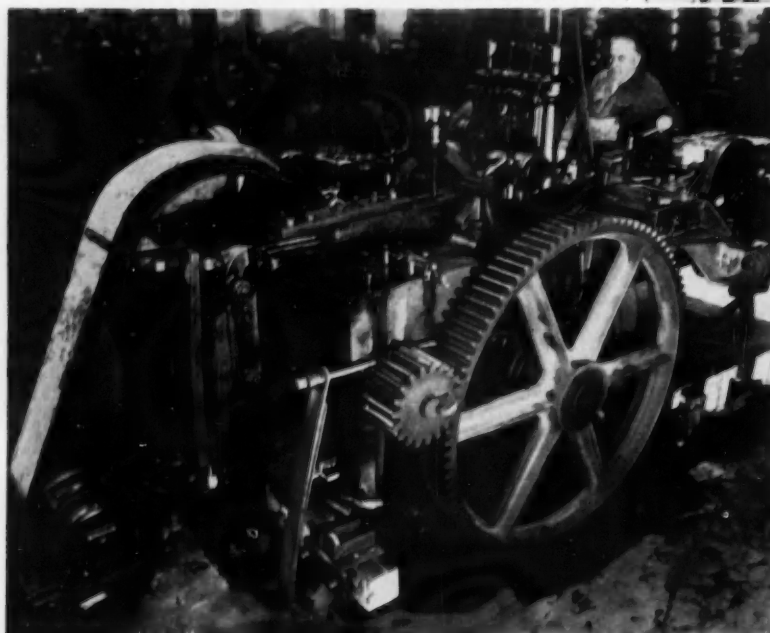
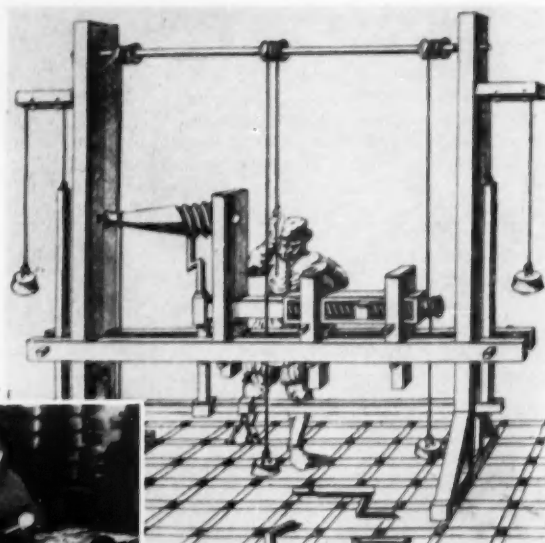
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SINEWS OF INDUSTRY

Air Tools Make It Possible to Apply Them
As Efficiently as They Are Produced

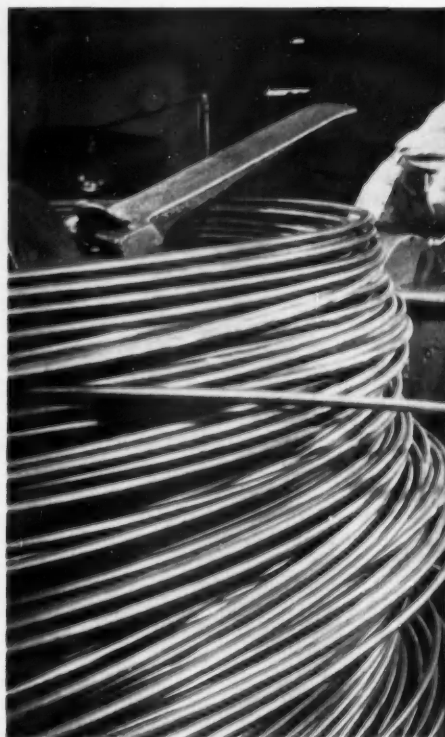
R. J. NEMMERS

BETTMANN ARCHIVE PRINT



OLD AND NEW SCREW-FORMING MACHINES

At the top is a screw lathe invented by a French engineer named Besson about 1569. It had a traveling tool holder moved by a lead screw. By using drive pulleys of various diameters it was possible to cut screws of any desired pitch. Illustrated above is the first bolt-making machine designed and built by William E. Ward about 300 years after Besson's. Still in operating condition, it is in the Port Chester, N. Y., plant of Russell, Burdall & Ward Bolt & Nut Company. It rolls rather than cuts threads, thus turning out a uniform and strong product. Almost all bolts less than 1 inch in diameter are manufactured on machines based on ideas proved feasible by this 100-year-old tool. At the right is a modern bolt-making machine to which stock is fed automatically from the coil in the foreground. Nut and bolt making is highly automated; a worker needs skill to set up and run the machine but uses little muscular energy.



THERE is some argument about whether the screw should be included in man's list of basic tools. Certain historians put six in that category—the wheel, the lever, the inclined plane, the wedge, the pulley and the screw. Others say that only the first three belong there because the pulley is essentially a wheel and both the wedge and the screw are adaptations of the inclined plane. There is no doubt, however, that the screw principle is vital to our civilized world. Indeed, fasteners of all types, most of which are threaded,

are so commonplace that it is hard to visualize life without them.

The United States fasteners industry is a complex business. About 30,000 people are employed in the highly automated production phases and use in the neighborhood of 2 percent of all the steel made, plus large quantities of other metals. Some 200 million fasteners are turned out each working day—nearly 60 billion valued at \$450 million annually. They range in size from giant through bolts designed to absorb stresses encountered in the world's largest metal-

working presses to common wood screws and to bolts so small that about 3000 of them (including nuts) are needed to make a pound.

Although archeologists have found evidence of five of the tools on the list in ruins dating back many centuries before the birth of Christ, the screw did not make its appearance until the third century B.C. Archimedes, famed thinker and inventor of that age, is believed to have been the first to apply the principle to his water snail or screw, a type of water lift still used in Near Eastern

countries. The heroic Greeks availed themselves but little of the other mechanical aspects of his discovery, and it remained for the more practical Romans to apply it in ways familiar to us. Wine presses, obstetrical instruments with power screws, wood screws, and arms and armor with nut and bolt fasteners have been recovered in the remains of their ancient cities.

Roman screw threads were fashioned painstakingly by hand, and many of those designed for the transmission of movement or power were carved in hardwood. Nuts and bolts of metal, while not common, were in use, especially in the more highly developed regions. Those of soft metals were carved like the wooden screws, but those of hard metals were built up in a crude yet ingenious manner. Two wires were closely wrapped around a mandrel and then carefully separated. One of these helices was soldered to the

suits of mail worn by knights, and much furniture was being constructed with screws. Other less pleasant and honorable applications were discovered by the religious and military fanatics of the day, for the screw enabled them to practice a cruel form of torture to wring "confessions" from heretics and to obtain information from their enemies. It is no credit to man that the finest and most carefully fashioned threads were for a time found in dungeons rather than on labor-saving tools and machines.

By 1500 German watchmakers were not only assembling parts with screws but using screws with slotted heads as well, from which we can deduce that the screw driver had come into being. Agricola, earliest of the scientific miners, refers in his *De Re Metallica* to screws both as boring instruments and fasteners. By 1569 they were in such demand that a machine was developed by a Frenchman

named Besson to do away with the tedious hand-cutting of threads. It was based on the lathe principle and had a master or drive screw which carried the shaping tool. But news traveled slowly (even though the Gutenberg printing press had been made possible by screws), and more than 150 years elapsed before Besson's machine came into widespread use.

About the time the American Colonies first began to flaunt the power of Mother England, Britishers Job and Will Wyatt improved upon the Besson lathe and began to produce threaded fasteners in large quantities. But even though the output of the Wyatts and others who followed was much greater than that of the Romans, the quality was little better. Bolts and matching nuts still had to be kept tied together, and interchangeability of parts was not even dreamed of.

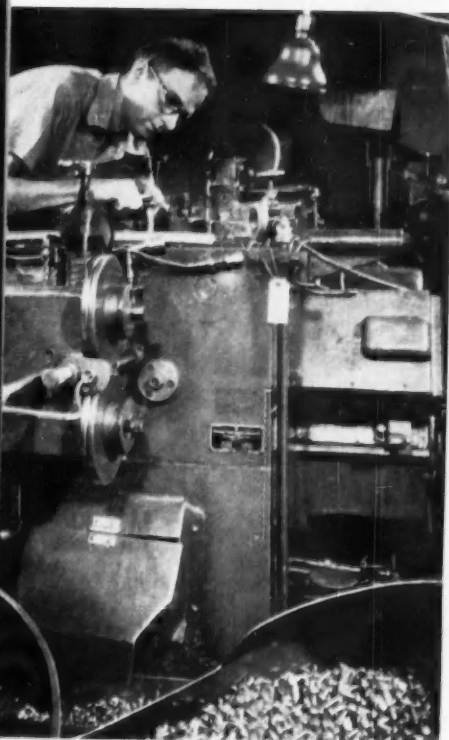
Sometime during the eighteenth century wood screws finally were given gimlet points — up to that time they had differed little from bolts. (By today's standards threads were invariably very coarse — indeed, early bolt threads resemble our wood-screw threads more than they do those of modern bolts.) By 1800 steam power made it necessary to produce bolts and screws not only faster but also better. An Englishman, Henry Maudslay, devoted himself to the task of improving screw-cutting machinery. He built the first all-metal machine (formerly they had had wooden frames) and thus provided a more rigid and accurate piece of equipment.

But no machine can turn out screws that are better than its own master drive screw, and so Maudslay set about trying to fashion a near-perfect and true master screw. After working ten years on the project he finally came up with one that he considered satisfactory. It was 7 feet long, and one of its first jobs was to make others like it so that additional screw machines could be constructed. And, most important of all to the booming Industrial Revolution, the majority of the nuts or bolts of one size produced by them were interchangeable.

The infant business spurted ahead unfortunately without direction, and each manufacturer developed his own standards and his own design of thread. The result, of course, was chaos, for bolts and nuts from one firm had absolutely no relationship to those from another. Joseph Whitworth (later knighted) was a pupil of Maudslay's, and he became the crusader for interchangeability. In the

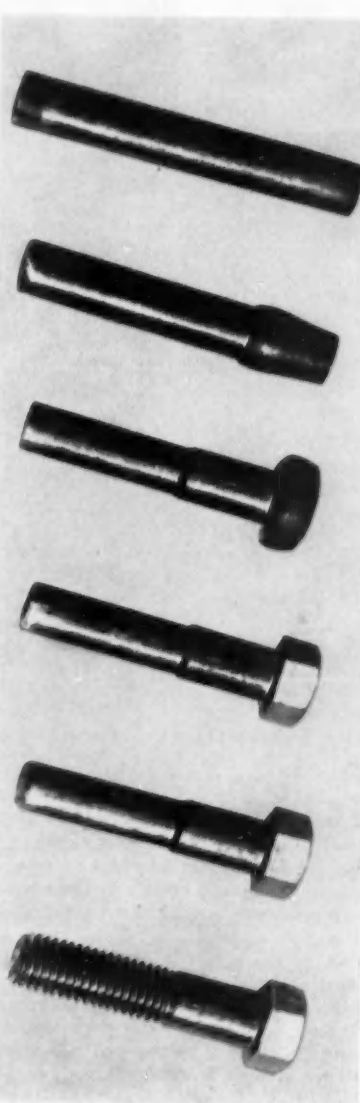
A BOLT TAKES FORM

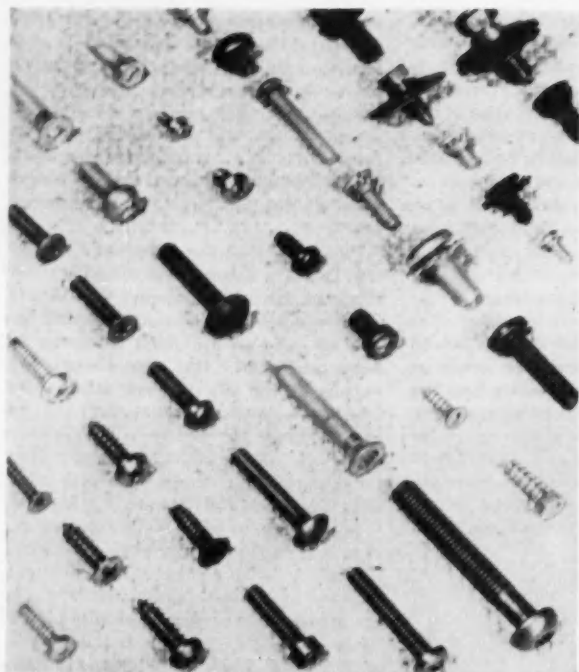
All the operations in the sequence are performed on one machine. Top to bottom: the raw material; after the initial swaging operation; after cold-heading; after forming the hexagonal head; after trimming and dressing; and after thread rolling.



mandrel to make a bolt, the other to the inside of a tube to form the nut. Fasteners produced in this way were interchangeable only by accident, and a matching nut and bolt were kept tied together until needed. Bolts were often headed by inserting a pin in a hole drilled near the top. The pin not only prevented it from working through but also served as a means of tightening the assembly.

After the Dark Ages, during which the screw-thread principle was almost lost, armorers began to use nuts and bolts to hold together the superbly fashioned

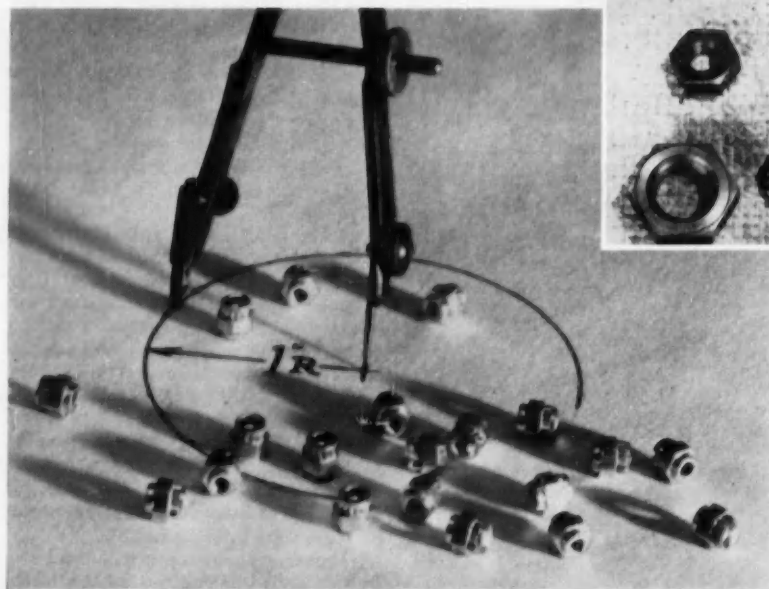
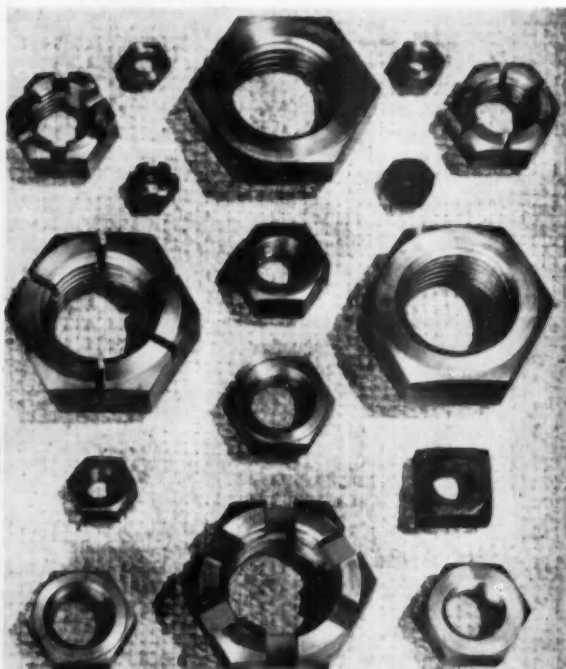




ASSORTMENT OF PRODUCTS

The fasteners industry consumes more than 2 percent of the nation's steel in turning out more than 250,000 different types and sizes. Pictured at the bottom are twenty tiny self-locking clinch nuts by which small "blind" components are mounted on thin panels. A 1-inch-diameter circle has been scribed around some of them to show how small they are. Below are just a few of the more common nuts used in industry; at the left are some of the great variety of bolts and machine screws available. Every common type of head is shown.

PHOTOS, R B & W NUT & BOLT CO.



PHOTO, STANDARD PRESSED STEEL CO.

early 1840's he worked out a thread design incorporating many of the things he thought best in the hodgepodge of thread forms then in existence. He spent an astonishingly short period selling the idea of making his thread standard (either he was a master drummer or the time was ripe for such a novel scheme).

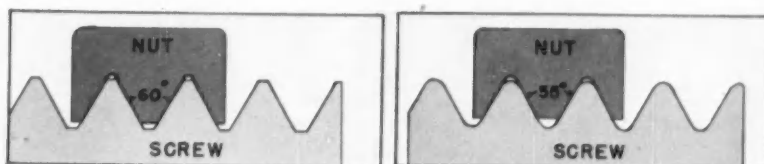
England soon settled on the Whitworth thread form, but twenty years elapsed before American industry caught up with the idea of standardization. But instead of adopting a thread corresponding to that of the English, a completely different type was chosen. Known as the

Sellers Thread, it was designed by William Sellers, a Philadelphian. The result of this oddly archaic action was that Americans and Englishmen, although they spoke the same language, were not able to repair each other's machinery or even replace a missing nut on the simplest of equipment.

In the years prior to World War I this situation was only a minor inconvenience, but during the conflict it became a very serious matter. After the armistice, however, the few voices that had cried out for a world standard thread, or, at the least, for a unified American-British

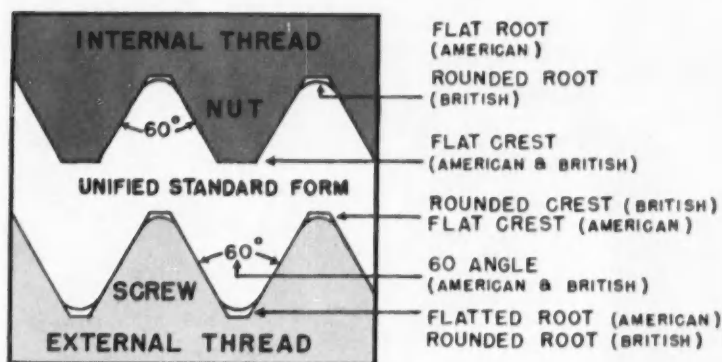
thread, were lost first in the general business downturn that followed and later in the prosperity of the twenties. Then when World War II was upon us, it was too late to try to adopt a standard. American goods had to be furnished with American nuts and bolts for every repair job, even the most minor one. And with the United States the chief Allied supplier of arms and munitions, the lack of a unified screw thread made the military's problem of logistics inconceivably tough.

As the end of the conflict neared, the first of a long series of conferences was held to settle on a unified thread form, and a new standard was finally adopted in 1948. Provisions were made to resolve the difficulties associated with the changeover to the new design, and although some questions have not been satisfactorily answered even yet, a great deal of progress has been made. The next inevitable step is a world standard, and some work in that direction has been done by the western free nations. Not only will a single standard be of great value in the event of another global war; it will be equally advantageous in peacetime and may help to stimulate world trade.



THREAD FORMS

Above, left, is the American or Sellers standard form which has a 60-degree thread angle, and at the right is the Whitworth or British standard with a 55-degree thread angle. The new unified standard thread form, below, incorporates features of both the earlier forms.



As the distinguishing features of the Whitworth, Sellers and Unified Standard threads are shown in detail in an accompanying sketch, we will not describe them here except to note the changes necessary to achieve unification. The Whitworth thread has an angle of 55° with rounded crest and root. The American thread has a 60° angle with flat crest and nominally flat root. The Unified thread retains the 60° angle of the Sellers form and may have either the British-style rounded crest and root or the American flattened type. But the important thing is that an American nut will fit an

English bolt of the same size, or vice versa. Naturally, a great many considerations entered into the decision to adopt this particular form, but all of them need not be gone into here. One of the reasons for using the 60° thread angle in the Unified form is that the thread for any given height and pitch contains the largest possible amount of metal.

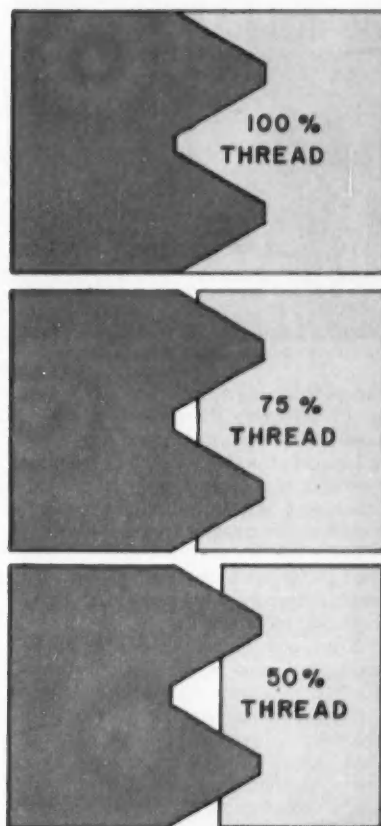
The foregoing in no way implies that all American threads can in future be mated with all British screw forms of the same nominal size, for many odd ones are still made in both countries for special applications. American screw manufacturers are trying to reduce the number of odd threads, and users are cooperating out of sheer economic necessity, as well as a desire to promote standardization. With the industry as highly automated as it is, reductions in production costs can be achieved only by long runs on standard fasteners. Any deviation from the standard entails a lot of expense because of the necessary changes in tooling and schedules. Thus customers who have specified a special size or type in the past are attempting to redesign their products so as to permit the use of standard forms and thereby save the money now spent on screw-thread oddities.

The principal advances in threaded fasteners and power-transmission devices before the twentieth century largely concerned the physical form—the included angles, relation of pitch to depth, and shape of the thread crown and root, for example. Great strides were also made in the precision of the thread itself and the diminution of manufacturing tolerances. Then, with the advent of

modern metallurgy and increasing engineering knowledge of stresses and strains, striking improvements were noted in all types of threaded equipment. Today, a seemingly simple nut and bolt is a carefully engineered product, and the intricacies of design of each one are not often fully known or recognized.

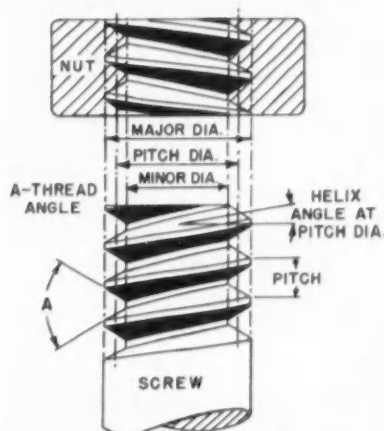
For instance, it is not always enough that a bolt be made of the proper grade of steel; in some cases it must also be carefully heat treated to bring out the most desirable properties of the metal. If so, decarburization of the material must be carefully guarded against, for even a shallow layer of decarburized steel on the surface of a bolt may lead to what are known as stress raisers. These areas of concentrated stresses may weaken a bolt to such an extent that it soon fails when subjected to repeated flexing, a situation metallurgists and engineers call dynamic loading. Likewise, the very shape of a bolt may form stress raisers.

Examination of a carefully designed



THREAD DETAILS

Sketches showing the differences between 50-, 75-, and 100-percent internal threads. The 75-percent thread is used for most applications in this country. It is much easier to make than the 100 percent, yet is of almost equal strength. The 50-percent thread, however, is more easily stripped when tightened.



SCREW-THREAD TERMINOLOGY

The main features of both external and internal threads are identified here. Most of the design points illustrated are now firmly standardized. Any new developments will probably be in the fields of materials and treatment.

ONE AT A TIME — AND TWENTY

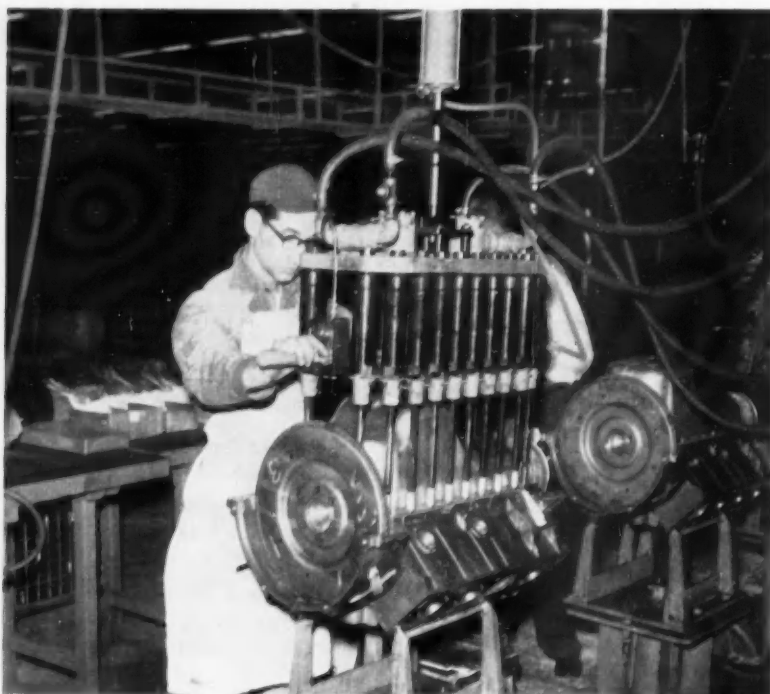
Shown below is one of the first power-driven nut runners used in the automotive industry. Adapted from the Little David air drill, it served to run down cap screws on a transmission housing for an early automobile. At the right is a modern multiple-spindle unit simultaneously running twenty cap screws on an engine oil pan. Newer designs of the latter type not only do the entire job automatically but also place the cap screws without human assistance.



threaded fastener will show that there are no extremely sharp changes in direction. It has been found that a bolt may fail quickly if a sharp 90° angle is formed between its shaft and its head. On the other hand, if a filet or rounded corner is specified, the stresses are measurably reduced. Besides actual design specifications, bolts can be strengthened in other ways primarily associated with manufacturing techniques.

Nuts have certain special design features that also should be mentioned. For example, they are generally made of a softer material than their corresponding bolts. If both were of like hardness, then minor thread variations would throw an undue amount of strain on a single thread section. But with a softer metal the nut undergoes slight deformation to match the bolt, thus distributing the load more evenly over all the threads. One of the reasons for using a softer material in the case of the nut is that it is relatively easier to overdesign it so as to compensate for lower strength than to make comparable allowances in the design of a bolt.

Threads of nuts and bolts may differ



slightly in height. In the case of some nuts, the thread height may be about 75 percent of that of the bolt. In other words, while the crests of the threads on the bolt go all the way into the roots of the nut, the crests on the latter stop 25 percent short of the roots of the bolt threads. There is a good reason for this: such a nut is easier to manufacture, and the stripping strength that would be gained by 100 percent rather than 75 percent thread contact is negligible in most instances—an increase in the neighborhood of about 5 percent.

The screw thread, it can be seen, is a tool that requires the use of many other tools to derive its maximum benefits. Early nuts were often of a type we would classify today as wing nuts—they had a built-in "wrench" that could be gripped by the fingers for tightening. Later, nuts and bolt heads were flattened on two opposing sides to accept the first crude wrenches. From that point on they evolved in spurts through square to hexagonal forms, and varying hand tools ranging from adjustable wrenches to the familiar socket type were developed to insure greater tightness.

From the inception of the screw driver in the fourteenth century most screws and many bolts had slotted heads as they have today. But even that feature came up for reexamination because slots often "stripped" or the tool slipped. Today we have other types of recessed screw and bolt heads as typified by the so-called Phillips and Allen heads. Lock washers were an important step forward in the field of the screw-thread fastener.

As with many inventions, the lock washer was originally, and in many cases still is, a separate piece, but many companies are marketing self-locking bolts and nuts. Some of these are illustrated.

One of the results of present-day methods of producing threaded fasteners is that they can be turned out much faster in terms of man-hours than they can be applied. In the last 50 years great emphasis has been put on speedier means of driving screws and running nuts. Early developments in that direction were the simple crank-type wrench and, soon thereafter, the ratchet wrench, both of which made it possible to complete the operations without removing the tool from the head.

Most of the speed tighteners of the manual variety that we have today were designed before World War I. Labor was still one of the cheaper things a manufacturer could buy in those days, so hand devices were good enough. Right after the conflict, however, Henry Ford conceived his assembly line, and power tools were needed. It was not long before the first power nut runners were in use in Detroit. They were an adaptation of portable pneumatic drills and did much to assure the success of the moving production line. Those first nut runners were operated by piston-type air motors, and by present standards were extremely heavy for the work they turned out.

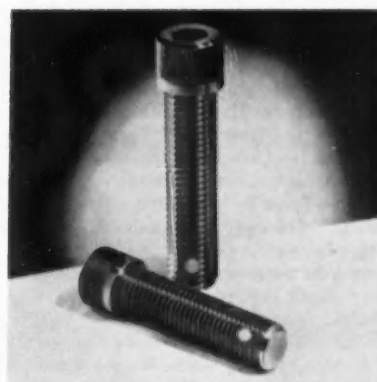
About 1928 power-tool manufacturers seized on an idea introduced by the old Imperial Pneumatic Tool Company of Athens, Pa., and came up with a vane-

type motor for tools that was much lighter than the old reciprocating model. The vane tool achieved success at that time because of other developments in a little-known branch of the chemical industry that has become the thriving plastics business of today. The first vanes were of steel, and the metal to metal contact between them and the cylinder couldn't be adequately lubricated with the oils and greases then known. But the problem was solved with the appearance of composition vanes, and by 1930 Multi-Vane tools were well established. Their advent did much to reduce worker fatigue, for one of the new units weighed only 5 pounds as compared with 9 pounds for a tool of the same capacity with a reciprocating motor. New materials and advanced design have reduced the weight of a comparable modern Multi-Vane tool to 3½ pounds!

The one major difficulty with the air-powered tools of that period was that they transmitted the developed torque to the operator. It was a fatiguing job to fight one of those wrenches all day. Finally, in 1934, Ingersoll-Rand Company brought out the pneumatic Impact wrench that, by converting steady rotary motion into rotary blows, applied

more torque or twist to a nut without any reaction on the operator. Even though the tool was introduced in the midst of the depression, it rapidly became a success and virtually changed many assembly techniques overnight. By 1947 I-R had come up with an electrical counterpart of the pneumatic Impact tool.

During World War II speed of operation was an essential in most manufacturing establishments, and the productive capacity of American industry was the wonder and marvel of the free world. Not the least of the problems associated with mass output was the driving of screws and the running of nuts. It was then that engineers conceived the idea of linking several pneumatic tools together to drive more than one screw or to run more than one nut at a time. Many such applications were made in the closing days of the war as plant tool rooms fashioned multiple units from existing tools. In 1951 Ingersoll-Rand brought out the first factory-built units engineered to do a specific job and consisting of air tools connected to custom-made manifolds and of specially designed counterweighted suspensions. In most of these cases torque-type tools were utilized because they could be arranged to



PHOTO, STANDARD PRESSED STEEL CO.

SELF-LOCKING SCREWS

Nylon pellets inserted in the machine screws are deformed in service and wedged between threads. Called Nylok, this feature is found on many fasteners.

act against one another and in that way transmit no torque to the operator.

By 1954 the technique of applying screw-thread fasteners finally caught up with the methods used to produce them. I-R added some automatic features to its Multiple Nut Runners that fitted them for today's automated assembly lines. These include machine placement of screws and nuts that makes it possible to dispense with the tedious job of manual positioning and starting, as well as power feeds controlled by limit switches on indexing conveyors or tables that permit the machines to operate virtually unattended. Naturally, as with other automated equipment, there are built-in devices which warn workers if something is wrong—if a fastener is missing, for example.

Scientists are reluctant to accept anything at face value—because something works is no reason, according to them, for not digging further to determine just what principle does make it work. They have arrived at a new understanding of screw-thread fasteners that even now is revolutionizing the design and erection of structural steel. This calls for the use of a special type of fastener, known as a high-strength bolt, that is made of a heat-treatable high-carbon steel. Heat treating the fastener gives it increased strength and improves the elasticity of the metal—makes the bolt more ductile. The latter property is extremely important because of the technique now used to tighten bolts. Perhaps the idea behind it can best be explained by drawing an analogy between a high-strength bolt and a spring.

Let us suppose that two metal plates 100 square inches in area are to be fastened together. We know, because of our design calculations, that the force tending to separate them will at no time be more than, say, 10 psi. Further, we know that shear forces will in no case



PHOTO, THE SHEFFIELD CORPORATION

TENSION MEASURING DEVICE

This air gauge measures how much a bolt stretches when tightened in an assembly. One of the latter is shown at the lower right. Each is tightened and gauged individually and is turned until a pointer on the scale registers zero, thus assuring even tightness throughout. Minor variations in bolt length are compensated for automatically.

Disneyland

Compressed Air Helps to Create Realistic Illusions
At Fabulous Playground for All Ages

WILLIAM THOMAS



WALT DISNEY, a creative genius who has the capacity to make his dreams come true, has made even his biggest one a reality. For more than twenty years he envisioned a playground for people of all ages that would become a source of joy and inspiration to everyone who came to see it. The result is Disneyland, a fabulous \$17-million park located about 25 miles south of Los Angeles at Anaheim, Calif.

Opened to the public on July 18, 1955, Disneyland is a park where fantasy and imagination are companions of reality. Its 60 acres are divided into five "realms of enjoyment"—Main Street, U.S.A., a replica of the principal street of a small-town at the turn of the century; Tomorrowland, a look into the future; Fantasyland, a storybook world come to life; Frontierland, where American history can be relived; and last but by no means least, Adventureland, where you can satisfy your yearning to visit far-away tropical places.

In designing and building Disneyland, nothing was left to chance. Disney's original plans were to construct the park on his studio lot in Burbank, Calif. However, as his cartoon family and other activities grew, so did his dreams, and it soon became apparent that something far larger than the Burbank lot would be needed.

The site was of prime importance, and its selection was made after a year's study of many locations and a complete search of land records. Accessibility, topography, available utilities and environmental characteristics of various places were investigated. Even annual rainfall figures were looked into and helped in making the final decision. As it turned out, the site chosen was a 160-acre orange grove at Anaheim, just off the Santa Ana Freeway.

Even before the property had been



PAST AND FUTURE

Upon entering the 160-acre playground, visitors walk down Main Street, a thoroughfare modeled after one in a small town of the 1900's. It is served by four street cars and a chemical fire wagon, all horse-drawn. Shops are like those of 50 years ago and operated as they were then. Amusement places include a shooting gallery and a theater that shows silent movies. In contrast to this old-style setting there is Tomorrowland. Among its attractions is the "Rocket to the Moon" ride (top) on which time, space, motion and loss of a sense of gravity are all authentically simulated to make the journey seem realistic. As a part of this make-believe, unseen air-operated devices impart vibration to the seats.

purchased, the search to secure authentic equipment for the project was underway. It took three cities to supply the 100-year-old gas lamps that line Main Street. Some of the cresting and the railing seen there and in Frontierland came from old plantations in Nashville and Memphis, Tenn.; others from San Francisco, Oakland and Sacramento. The hunt for early American interior designs extended into antique shops across the country. Because all structures and facilities are five-eighths normal size, mills across the nation were given contracts for special materials.

Authenticity was not confined to the buildings. Landscaping also presented many problems. Approximately half a million dollars worth of trees and shrubs were used to add reality and to set the theme for each of the "realms." Trees from many sections of the United States and from faraway places such as Aus-

tralia, New Zealand, South America, South Africa, China and Japan were planted.

During Disneyland's first year, 3,660,000 persons toured the Magic Kingdom. A 100-acre parking lot accommodating more than 12,000 automobiles was constructed. The answer to the problem of providing visitors with food was incorporated in the over-all plan in the form of no less than twenty restaurants and snack bars capable of serving 9000 hourly. These have been strategically located throughout the 60-acre exhibition area.

Actual construction of the park was begun on July 17, 1954, exactly one year and a day before it was officially opened to the public. Statistically speaking, 3½ million board feet of lumber went into the project; more than three million square feet of paving covers Disneyland and its parking lot; and approximately

exceed the friction produced by a clamping force of, say, 12 psi. To be on the safe side we will fasten the plates together by loading them with a spring constructed so that it takes a pull of 1500 pounds to stretch it. Thus the force holding the two plates together is 15 psi, and under the conditions we have set up they cannot be separated or moved in shear. The only requirement in fastening the plates with the spring is that it must be tensioned initially with a force of at least 1500 pounds. The same thing holds true in high-strength bolting. After design considerations are established, a bolt meeting those specifications is selected and then tension equal to the load (plus a safety factor) is applied by drawing up the nut to that particular point.

One other consideration must be allowed for in applying a spring: care must be taken not to exceed its limit of elasticity—that is, stretch it so far that it will not exert the 1500 pounds of force needed. That also holds true for bolts.

However, in the case of the latter a simple means is provided to avoid over-stressing them. If too much tension is put on a high-strength bolt it simply breaks and can be replaced. It will not break in service unless it corrodes or is subjected to a load greater than that for which it is designed.

Actually there is nothing really new in the idea of high-strength bolting—all the rules have been known in one form or another for some time. However, its application to structural steel is new. Tensioning bolts properly has long troubled manufacturers of all types of equipment. One way of gauging tension put on a bolt is to measure the amount of torque required to turn it (or its nut). This value is an indication of the tension on the bolt itself, but it can never be more than an approximation because of the number of variables that enter into the matter. It can be influenced, for example, by the friction of the nut against the washer, or by minor variations in the threads. Nevertheless, the best way to determine

the tension on a bolt is to measure the torque. That is entirely satisfactory because fasteners can easily be designed to exert the proper clamping force over a rather wide range of tension. Then all that is necessary is to tension the bolt to some value within that range—preferably somewhere near the midpoint—and it will do its job without failure.

Present-day techniques make it possible to tension a bolt within a certain range by controlling the torque used to tighten it. Manually operated torque wrenches have been in existence for some time, and a power impact-type tool with built in torque control which permits it to run at full capacity and speed has recently been put on the market. Called the Torsion Bar Torque Control Impactool, it eliminates many of the difficulties previously associated with attempts to control the torque exerted by a power tool.

The new unit makes use of a torsion bar, which is prestressed or twisted to a given value. The tool operates at full speed and develops full-powered impacts until the torque exerted exceeds the preset value. Then the torsion bar is twisted just a little bit more, and the additional rebound serves to trip a valve and to shut off the tool. Ingersoll-Rand Company, which introduced the pneumatic Torsion Bar Torque Control Impactool in 1955 lately placed electric motor-driven types on the market.

Of course many other developments both in fastening methods and in fasteners have come along in recent years and brought about either greatly speeded-up operations or stronger, more trouble-free unions. Self-tapping screws for certain kinds of sheet-metal fabrication are one example. We have already mentioned self-locking screws and some nut-and-bolt combinations that require a greater torque to disassemble them than to put them together. New and much lighter air and electric tools, including "high-cycle" units—those powered by motors supplied with electricity at a much higher frequency (180 or 360 cycles per second) than the usual 60 for home consumption—are now available, as are new sizes designed to handle extremely large fasteners.

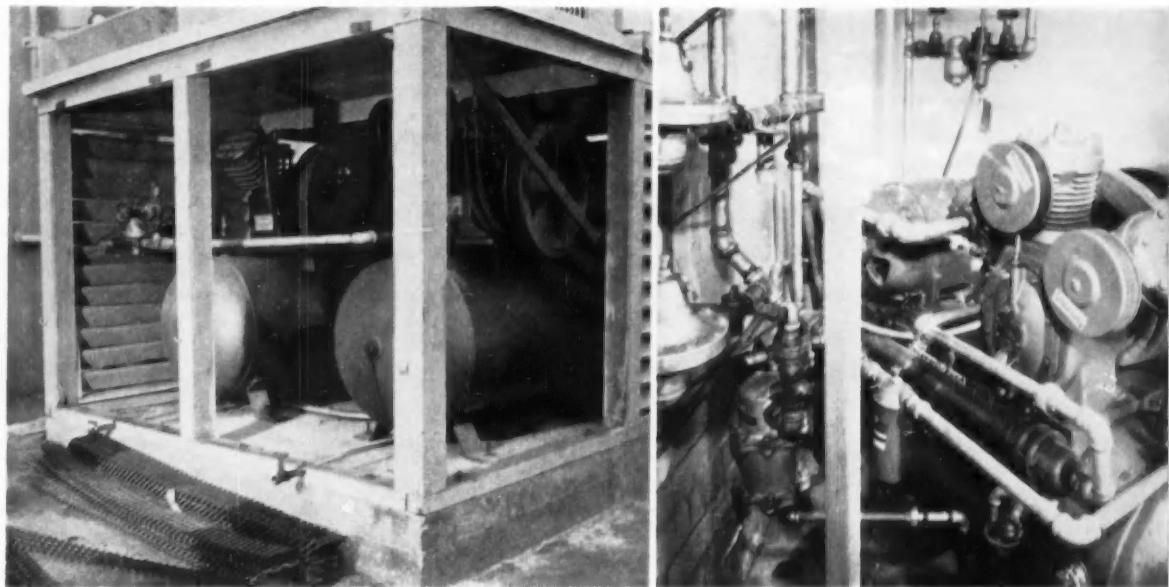
Some prognosticators are of the opinion that the day will come when welds will be in common use except where threaded fasteners will be needed because joints must later be separated. However, it is only fair to point out that bolted joints will frequently be stronger—even stronger than the material surrounding them—and that in most cases nuts and bolts are not only easier and faster to use but are also cheaper and require less skilled labor. At any rate, threaded fasteners and the tools with which to apply them are indispensable to our material welfare and are keeping pace with our industrial development.



THE TOOL AND THE FASTENER

High-strength bolting is a rapidly growing technique in the construction industry. Illustrated in action is a new type of Impactool which, by means of a torsion bar, controls the torque used to run nuts. Manufactured by Ingersoll-Rand Company, the Torsion Bar Torque Control Impactool, as it is known, does not call for skilled labor to operate it, yet applies all bolts with uniform tightness. The high-strength bolt at the right is identified by three radial dashes on the head. The central "E" stands for Empire, a trade-mark of Russell, Burdell & Ward Bolt & Nut Company.





MACHINES BEHIND THE SCENES

Five Ingersoll-Rand motor-driven, air-cooled compressors spotted around the grounds lend reality to some of the attractions. Two of the machines (left) provide power to open doors and animate characters seen on Mr. Toad's Wild Ride, during which a 1903 model automobile runs down a cow and crashes into a barn. The unit shown at the right serves to add realism to the rocket trip to the

moon. Air from another stationed in Tomorrowland animates a giant squid that threatens to demolish an atomic submarine from which many wonders of the sea can be viewed. The fifth compressor supplies air to help start the locomotives of the Santa Fe & Disneyland Railroad that encircles the grounds. There is one passenger and one freight train accommodating 300 persons.

adventures in a small replica of a 1903-vintage automobile. Compressed air from two I-R Type 30 compressors operates pneumatic rams that open doors and animate some of the characters seen on this rollicking ride.

Frontierland is surrounded by a stockade reminiscent of pioneer days. The logs for this barrier and for the cabins within were cut in the Arrowhead region of California and shipped to the Disneyland site. There they were hewn by workmen picked from among carpenters who had log-cabin or shipbuilding experience and were familiar with the use of axe and adze. The only power tool on the job was a chain saw driven by a gasoline engine.

Among Frontierland's many attractions is the 105-foot paddlewheel river boat *Mark Twain*. Typical of the steamers that plied the Mississippi in 1900, it carries passengers on a 1/2-mile circle trip down the "Rivers of America." A unique guide-rail assembly beneath the water keeps the vessel on its course. Visitors to Frontierland can relive phases of America's westward march by boarding a stagecoach or Conestoga wagon or by joining a pack train for a trip across the Rainbow Desert where they will find many surprises as they ford a stream and pass a deserted mine.

In Adventureland, which typifies a Tahitian village, a cruise on an explorer's boat will take you down the tropical rivers of the world. Lifelike savage na-

tives and wild animals peer at you from the lush vegetation along the banks. In the background you can hear the chatter of monkeys and the trumpeting of elephants. A silent and mysterious pagoda keeps its vigil in the dense foliage of the Indo-Chinese area. A waterfall is narrowly missed by the vessel's expert navigator, and rapids must be "shot" before you are safely back at your starting point. Here again, a guide-rail assembly serves to keep the boat in its channel during this adventurous journey.

Leaving Adventureland and returning to Main Street, visitors might choose to ride on the Santa Fe & Disneyland railroad which encircles the park. The two engines that chug along on the 1 1/2-mile track are scaled-down replicas of the steam engines that operated in this country in the 1890's. A passenger and a freight train are in service, and each can accommodate 300 people. They are started on their runs from the roundhouse with the help of compressed air, which is supplied by a 10-hp Type 30 compressor and provides the forced draft and atomization necessary when firing up the engine boilers.

Walt Disney, who made Disneyland a reality, was born in Chicago in 1901. His father was Irish-Canadian and his mother was of German-American descent. Educated in public schools in Chicago and Kansas City, he attended art school in Chicago. When Disney first went to Hollywood in 1923 his as-

sets consisted of \$40 and boundless imagination. He and his elder brother Roy, a partner in all his ventures, set up a cartoon studio in the back of a real-estate office. Now a multimillion-dollar studio in Burbank houses Walt Disney Productions, of which Roy is president.

It was the introduction of that all-time favorite cartoon character Mickey Mouse that started Disney on the road to fame. Silly Symphonies, a series of short musical comedies, came next, and in 1937 *Snow White* set a new pattern in the feature-length motion-picture industry. Some of Disney's more recent productions include *Lady and the Tramp*, *Davy Crockett*, *King of the Wild Frontier*, *The Littlest Outlaw* and such true-life films as *The African Lion* and *The Vanishing Prairie*. Feature-length *Sleeping Beauty* is currently in production.

In addition to his motion-picture activities, Disney entered the television field on a big scale. Disneyland, a weekly hour-long show was introduced in October 1954 over ABC-TV. With its success insured, the American Broadcasting Company contracted with Disney for a new hour-long daily television show for youngsters. Thus *The Mickey Mouse Club* made its debut in the fall of 1955.

Through his motion pictures, Disneyland park and his television programs, Disney has made many contributions to the field of entertainment. It remains to be seen what his next venture will be.



SLEEPING BEAUTY'S ENCHANTED CASTLE

This is a faithful representation of a medieval structure, even to the towers and parapets. It stands at the entrance to Fantasyland, which is filled with storybook characters, as well as some others conjured up by Walt Disney and his staff. One of its attractions is a theater that shows only Mickey Mouse films, and among the rides to be enjoyed there is one on Dumbo, the flying elephant.

32,000 sacks of cement were used. Excavations for the waterways supplied a large part of the 350,000 cubic yards of dirt that was moved during the building operations. Some 800 men were employed daily, with the figure running up to 2500 working 10-hour shifts as the opening date neared.

Employees serving on the permanent Disneyland staff number from 850 to 1000, and their occupations range from bus boys to riverboat captains; from livestock handlers to receptionists. All are required to attend "orientation classes," part of a training course to acquaint them with Disneyland policy and its way of life.

When you enter Disneyland you find yourself in a typical small town in the United States at the turn of the century. Its leisurely pace is set by horse cars stopping to pick up and discharge passengers in the friendly unhurried fashion of the 1900's. The city hall, opera house and fire station, complete with horse-drawn hose and chemical wagon, get first attention.

As you walk up Main Street you pass The Emporium, bakery, ice-cream parlor, grocery store, meat market and many other shops and stores—all with decor to preserve the atmosphere of the period. At the end of Main Street is the Plaza, Disneyland's hub from which any of the "lands" can be reached.

First let us visit Tomorrowland where many interesting and exciting exhibits of scientific conquest and things to come are presented. Architectural treatment

of all the buildings is representative of the year 1986. There one of the most exciting rides, and perhaps the most scientifically accurate, is the "Rocket to the Moon." On this simulated excursion into space, passengers experience the

powerful thrust of a jet take-off, the whine of rushing air and the utter quiet of hurtling faster than sound toward the moon. Through the giant panoramic viewport they can observe the earth, the moon and the other wonders of space travel as the captain of the ship presents a running account of these phenomena on its intercom system.

Some of the realism of this adventure is contributed by an Ingersoll-Rand air-cooled compressor which supplies air to vibrate the seats in the rocket ship to give the passengers a sense of motion. The operation of the compressor is synchronized with the projection and sound equipment. In the Jules Verne exhibit "20,000 Leagues Under the Sea," air from a 7½-hp Type 30 unit is used to animate the giant squid as it attacks Captain Nemo's submarine the *Nautilus*. It also bubbles the water in the diving chamber, thus lending reality to the scene.

Adjoining Tomorrowland is Fantasyland, described as a world of imagination come to life. It is entered through a replica of Sleeping Beauty's castle where a variety of rides and other attractions await you in the courtyard. For instance, you can join Peter Pan in a pirate galleon to spend several exciting minutes soaring high over London, Never-Never Land, Skull Rock, and Captain Hook's hideaway; visit Snow White and take a trip through the Seven Dwarf's diamond mine, or ride on King Arthur's carousel. Mr. Toad's Wild Ride takes you through a series of mis-



THE OLD WEST

The log-stockade entrance beckons visitors to enter the world of Davy Crockett and other famed frontiersmen where one can ride in a Conestoga wagon, buckboard, stagecoach or even on muleback. And then there is the paddlewheel boat "Mark Twain" which plies the Rivers of America. Thirsts may be slaked in Slue Foot Sue's Golden Horseshoe Saloon where nothing stronger than soda pop is served.



STRETCH OF PAVED ROADWAY

The Northeastern Extension differs from the previously built sections of the system in that it has a narrower central dividing zone between the traffic lanes. As shown above, it takes the form of a raised concrete structure 4 feet wide. Overpasses are plain but attractive.

CONSTRUCTION of the 110-mile Northeastern Extension of the Pennsylvania Turnpike is entering its final stages. The easiest 48 miles to build has been in service since last December. It extends from Plymouth Meeting, near Philadelphia, across generally gently rolling farm country to a temporary interchange near Emerald in the Slatington area. The remaining 62 miles, most of which traverses rugged mountainous terrain, is scheduled to be opened by the end of this year. Only 33 months will have elapsed since the initial contracts were let on March 9, 1954.

Although construction costs have more than quadrupled since the first 160-mile stretch of the Pennsylvania Turnpike was ready for traffic in 1940 studies of the current project before it was undertaken indicated that it would be self-sustaining. As one of its main benefits, it is expected to bolster the sagging economy of the anthracite-coal region centered around Scranton and Wilkes-Barre, which the extension will skirt. Considerable progress has been made towards diversifying the area's sources of income by attracting manufacturing plants, and it is thought that the new highway will assist the movement. When it opens, driving time between Philadelphia and Scranton will be approximately the same as flying time, if the distance to and from airports is included.

Thirty-seven miles from its southern end the new pike link skirts the impor-



EXCAVATING DEEP CUT

The northern section of the route is largely a succession of cuts and fills across mountainous terrain. This view shows a long and deep sidehill cut as it was being excavated by Central Pennsylvania Quarry, Stripping & Construction Company. The white line at the right is a typical concrete-paved drainage ditch for diverting runoff water.

tant Allentown-Bethlehem industrial district and crosses U.S. Route 22, a main east-west travelway that starts at New York City, some 100 miles eastward. A few miles farther north it will enter the Pocono Mountains, a popular vacationland with 200 resort hotels and inns. One general benefit anticipated is reduction of truck-traffic congestion on free highways passing through or near cities and towns the extension will serve. It is hoped eventually to continue it into New York State to connect with the Thruway running from New York City to Buffalo.

Major specifications of the Northeastern Extension are the same as those that applied to the existing sections of the Pennsylvania Turnpike system: 200-foot right of way, two 24-foot strips of concrete providing 2-lane travel in each

direction, 10-foot outside stabilized shoulders, 6° maximum radius of curvature, 1000-foot minimum sight distance and 3 percent maximum grade. Instead of a median or center dividing strip 10 feet wide, it will have a 4-foot concrete mall 8 inches high. The established policy of building most of the line along the sunny sides of mountains is being followed.

The quantities of materials required are imposing. They include approximately three million barrels of cement and more than four million tons of stone, sand and classified earth for the subbase and concrete pavement, and 70,000 tons of structural and reinforcing steel.

Aside from the huge job of smoothing out the right of way and laying the pavement, the undertaking calls for the construction of 133 bridges, 142 culverts and

New Turnpike Link

110-mile Extension of Pioneer Pennsylvania
Toll Road Nearing Completion

C. H. VIVIAN

one extensive retaining wall, as well as the driving of the 4138-foot Lehigh (formerly T.J. Evans) Tunnel (described in our May issue). Four of the bridges are major structures across rivers and sixteen will span lesser streams. Fifty-six of them will carry the extension over other roads; 33 will take other roads over it. Eleven will provide grade separations at railroad crossings and thirteen will fit into the cloverleaf designs of the ten interchanges. One of the culverts, which conveys a stream under a high fill at a considerable angle, is 703 feet long.

The Appalachian Mountain chain runs southwestward across northeastern Pennsylvania in a succession of alternating ridges and valleys broken only occasionally by a wind or water gap. Extending generally north and south, the new highway strikes across this uneven terrain at an angle, and that requires a great number of cuts and fills to iron out the irregularities. One cut is 3000 feet long, and another called for nearly a million cubic yards of excavation. Fills up to 160 feet high have been made. Highway engineers generally try to balance cuts and fills, but it was not always possible to do that here and keep the maxi-

mum grade down to 3 percent. Consequently, excavation exceeds fill along the whole route, and on some contract sections considerable material has been left over. That has been deposited in low places near the right of way and graded to create level areas that may some day be used as building sites, recreation grounds or the like.

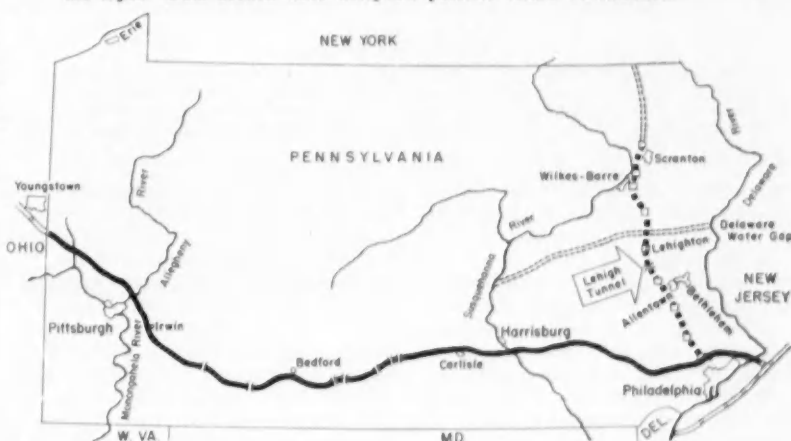
In addition to obstacles imposed by Nature, some caused by man have proved troublesome. On the outskirts of Emerald, south of the Lehigh Tunnel, 45 feet of water was pumped from an abandoned quarry and the hole filled in and then built up 15 feet to provide a bed for the highway. Also at Emerald, a bridge

100 feet high and 400 feet long was constructed to carry the Turnpike over several other quarries and a crossroad.

At intervals along a stretch of about 15 miles in the vicinity of Scranton, partly or wholly mined coal seams created a major problem. In some places as many as four of them are superimposed at different levels, and it was necessary to stabilize the ground under the highway down to the lowest one. Where there was coal not far below the surface, contractors were required to excavate to it, remove it and then compactly backfill the opening. This was true even where the roadway was to be carried on a fill extending above the ground level as it had

LOCATION MAP

The main east-west Pennsylvania Turnpike is indicated by the solid line at the bottom. The 110-mile Northeastern Extension is shown by the blocked line at the right. Dual broken lines designate possible future construction.



DIGGING DITCH

Buried drainage pipes run along one or both edges of the right of way in all cuts, with laterals at suitable intervals to deliver surface water to them. Two Ingersoll-Rand drifter drills mounted on towers on hydraulic booms attached to a tractor make a convenient drilling rig for

the pipe-trench excavations. The Hydra-Boom unit carries its own air supply—a Gyro-Flo 600-cfm portable compressor (right). Booms can be raised, lowered or swung horizontally by hydraulic power and holes can be drilled at any angle from horizontal to vertical.



CROSSING THE LEHIGH

The route includes three major bridges and numerous lesser ones. Shown is the lower of two crossings over the Lehigh River. This one is near Bowmanstown. Piers were built by the L & H Construction Company of Pittsburgh, Pa., and the superstructure is now nearing completion by Bethlehem Steel Company.

been when work began. It gave rise to the anomalous situation of having first to dig in order to fill in later.

To cite an example, on the W.E. Graham contract 48 feet of overburden had to be excavated in one place to reach a coal bed. After the coal had been extracted, the area was filled to a height of around 70 feet, or 22 feet above the original surface. Contractors performing this type of work generally used draglines to cast the material to the sides where it was readily accessible for quick backfilling. Anthracite coal is a pretty stable mineral and capable of supporting a lot of weight. Where lying flat and undisturbed it would perhaps not give way under turnpike travel. However, the beds in this region follow the folds of the enclosing rocks, and folding is pronounced. If coal lying on a slope were left alone, there would always be danger of its slipping, especially if mining had been done farther down the incline.

Wherever abandoned mine workings existed underneath the right of way at depths too great to permit excavating to them they were filled prior to grading with sand and silt run down from the surface through pipes. The old workings were located largely from blueprints of the mines. This entailed a lot of searching for records, and in some cases the only prints available were obtained from retired miners. Actually the Turnpike engineers laid out several optional routes through this section and later selected the one that required the least underground stabilization.

Most of the open spaces were filled in the following manner: vertical holes big enough to take 8-inch casing down to solid rock and 6-inch filled the rest of the way

were drilled 50 feet apart throughout a width of 250 feet along a total of 6 route miles. Hopper-funnels were fitted to the tops of the casings, in turn, for the introduction of the sand and silt. The sand came from pits opened by bulldozers and the silt from coal breakers or washing plants. End-dump trucks delivered 8- to 12-ton loads of the materials to a hopper, and they were then sluiced down the hole with water pumped from some nearby stream, lake or other source of supply. This process is known as slushing.

Filling continued until a hole would

take no more, and in excess of two million tons of material was sent underground. At some places there were mine openings on two or more levels, and all had to be taken care of. Where only part of a mine had been worked out and some coal remained to be extracted, a bulkhead was erected to confine the fill to the abandoned areas.

Construction of the entire 60-odd-mile mountainous section of the extension has been characterized by the extensive use of large blasthole drilling machines. This is a continuation of the trend noted previously in muck-handling equipment such as power shovels, trucks, carryalls, scrapers and the like. Increased emphasis was put on big drill rigs or more effective drilling combinations even as roadbuilding progressed and was part of a growing movement to shave excavation costs. An example will illustrate the effect this trend had on paring bids.

At the beginning of the program one stretch was let on a bid of \$1.37 per cubic yard of excavation. Some months later contracts in generally similar country and comparable in every way to the one cited went for as little as 70 cents a yard. Obviously, the firms taking the latter work had to find ways of cutting corners, and one of the chief means of effecting savings was to utilize drilling equipment that was larger or more efficient than that previously on the job.

Four of the contractors in the hard-going area each used from one to three self-contained, self-propelled Ingersoll-Rand Drillmasters each equipped with a "down-the-hole" drill and either a 6- or a 6½-inch Carset (tungsten carbide-insert) bit. As the name indicates, the drilling element goes down the hole. The



TROUBLESOME RIDGE

Near Bowmanstown the highway passes through Stony Ridge, an elevation that has a core of vertically standing quartzite flanked on each side by softer rocks. The crest is jagged and the slopes steep and the contractor had to adopt mountain-goat tactics when starting its reduction.



FILLS LEVEL DEPRESSIONS

View from below, left, of part of a 700,000-cubic yard fill on a section built by J. Robert Bazley, Inc. The trucks that appear tiny in the upper-left are 160 feet above the stream that flows under the fill in a concrete box culvert 575 feet long. In the foreground are several of the troublesome "bullheads" that occur in the strata in this area. Fills were built up in layers of material that was spread evenly by bulldozers (below) and then compacted by rolling before the next course was deposited.

bit is inserted directly in the front end of the drill, and no power is wasted in overcoming the inertia of a long and heavy steel. One of these compact Drillmasters, carrying its own Gyro-Flo 600-cfm rotary compressor, dust collector, hydraulic leveling jacks and hydraulic wrench for loosening and tightening rods and bits, will generally replace ten to twelve wagon drills and the three or four 600-cfm portable compressors needed to furnish them with air.

Considering that a Drillmaster requires no more operators than a wagon drill, its potentiality for saving money on heavy construction jobs is readily apparent. Other advantages not so discernible show up in connection with blasting operations. Because Drillmaster holes are spaced from 12 to 18 feet apart, as compared with 4 to 6 feet for smaller ones, the number to be loaded with powder is reduced. Furthermore, each big hole can be loaded almost as quickly as a smaller one because the cartridges are larger (usually on the order of 5x24 inches) and fewer are consequently used. Savings on labor alone of as much as 1 1/2 cents per cubic yard of rock broken have been registered. Then, too, fewer costly blasting caps are needed and economies here may run to one or two cents per yard of rock. In addition, powder in the bigger cartridges is less expensive, and that saving may reach two cents per yard of rock. Total savings from all these sources may amount to as much as five cents per yard, and that becomes important where a contractor has a million cubic yards or more of rock to handle.

Not every job warranted utilizing large drills, and even where one or more of them were present smaller machines were required to take care of shallow lifts, trim the slopes of cuts, excavate for drainage ditches, etc. In consequence, traditionally used wagon drills have been



much in evidence, carrying all the drilling load on some sections and supplementing big machines on others.

Rigs consisting of twin drifter drills mounted on a tractor and of a 600-cfm compressor to furnish operating air also have been popular. Most contractors assembled their own units or had it done in an equipment dealer's shop. A well-used Caterpillar D8 tractor, or its equivalent, was usually selected for the chassis, thus cutting down on the investment. Each drill is mounted on a wagon drill-type tower at the end of a hydraulically powered boom attached to the front end of the tractor. The result is a self-powered, self-propelled rig that markedly reduces the need for wagon drills and hand-held drills on the average roadbuilding job. Under the finger-tip control of smooth hydraulic power, booms are lifted, swung, extended or retracted without manual effort. Towers are quickly spotted where they are wanted and operators spend almost their full time in drilling and little in maneuvering the equipment into position and setting it up.

Experience indicates that one twin-drill tractor unit will do as much work as three wagon drills and with two to three men instead of from six to eight (three

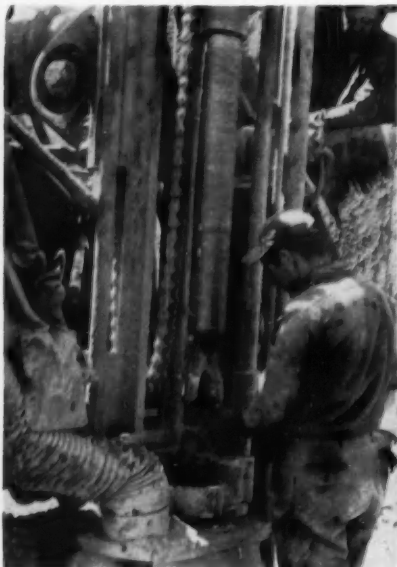
drillers, two helpers, one compressor operator and two additional men on a truck or tractor to assist in moving the wagon drills and the two compressors required to operate them). Long hose lines also are eliminated, and there is less chance of line breakage, air leakage or loss of pressure. As the booms can be swung through an arc of 100° and extended in length up to 16 feet, a considerable area can be covered without moving the tractor, making it possible to put down from six to nine holes, depending on the spacing. Compared with normal wagon-drill operations there seems to be a reduction of 50 percent in the cost per foot of hole and double the production per man-hour.

The rigs normally carry 12- to 14-foot steel-change towers and drill 14-foot holes without changing steels. On this undertaking, single units provided with 2 1/2-inch Carset bits repeatedly drilled 800 to 1000 feet of hole in a day. The bits recorded service lives of from 600-800 to 2000-2500 feet of hole in rock classified as hard. Steel bits were generally used in soft rock. Most of the contractors were equipped to sharpen their own bits, but they sent their drill rods to custom shops located in Scranton, Read-

ing or Philadelphia for reconditioning.

To give a comparative example, Lycoming Construction Company, of Williamsport, Pa., had ten to twelve wagon drills and six to eight portable compressors on the first of two sections built by it. On the second job, involving the removal of 1,044,000 cubic yards of material in grading $6\frac{1}{2}$ miles of right of way in terrain of much the same character, two Ingersoll-Rand Hydra-Boom rigs accounted for probably 90 percent of the drilling. Working two shifts, they kept muck in front of from three to five loading shovels working one shift. Lycoming completed the excavation in about nine months. For digging drainage ditches, this contractor devised a mobile drill rig by mounting two drifters on an extension of the blade of a bulldozer.

Shovels $2\frac{1}{2}$ -cubic yards in capacity predominated, with a few smaller ones and some 3, 4 and even 6 yards in size.



DRILLMASTER SCENES

Hydraulic jacks quickly leveled one of the three Ingersoll-Rand large-hole drilling rigs used by Bazley crews (large picture) thus enabling it to put down vertical holes on a slope. At the left is a close view of the down-the-hole drill with a Carset (tungsten carbide-insert) bit attached to its lower end. Bits were dressed on the spot (below) with an air-operated grinder that received power from the rig's compressor.



The number of large ones was kept down by the legal limitation of loads that can be transported on Pennsylvania state highways. A 2½-yard unit can meet the law by merely removing the dipper stick and dipper, but bigger ones must be considerably dismantled. Fines for exceeding the weight limit have ranged up to \$1500 per violation.

The average truck was in the 12- to 14-yard range, with some holding 16 to 18 yards. Most of the dynamite used for blasting was of 40-percent strength, with some 60-percent being employed mainly in and especially at the bottoms of the larger-diameter holes.

All grading contracts include paving and other finishing operations, but most of the primary contractors have sublet paving. One specialist in this line has paved a dozen or more sections. On some stretches a part or all of the stone for concrete aggregates has been produced from the cuts and crushed to size; otherwise most of it has been purchased, General Crushed Stone Company having supplied much of it from its quarry near White Haven.

As is usual on a project of this character and magnitude, top-notch contractors were attracted and have handled their work with dispatch and efficiency. Although practically every job has had points of interest, all are generally similar and we can do no more than hit the high spots of typical operations in some of the toughest sections.

Central Pennsylvania Quarrying, Stripping & Construction Company, of Hazleton, Pa., is completing two stretches of 2.73 and 4.07 miles, respectively, or a total distance of 6.8 miles starting at the north portal of the tunnel and running northward continuously except for bridges across the Lehigh River and Pohopoco Creek which are being constructed by other concerns. The shorter section involved the excavation of 1,250,000 cubic yards of which about 300,000 yards was shale that could be handled directly by shovels and the remainder was rock that had to be drilled and shot. Included in the latter category was the highest cut on the Northeastern Extension, a 2700-foot-long slash in a steep sidehill that reached a maximum height of 176 feet. The cut leads the highway onto a bridge across the Lehigh River. Some 200 feet below grade at the base of the almost sheer wall are the tracks of the Lehigh Valley Railroad, and great precautions had to be taken in making the excavation. Rocks were prevented from falling by leaving a retaining ridge along the outer edge of the shelf and pulling it inward as the final operation. The work was finished without delaying a train or damaging the tracks.

Farther north, on the outskirts of Bowmanstown, the route strikes across a high ridge that has resisted erosion because of a central layer of quartzite that

stands in a vertical position. As the survey specified carrying the highway through this section in a cut, it was necessary to dig deep into the jagged, precipitous ridge. Central Penn men in charge of the contract said it was the trickiest piece of work of its kind the firm has ever faced. The cut had to be started at the top, and for a time the loaded trucks traveled a makeshift road so steep that it called for low-gear, slow descent. Careful driving was strictly enforced, and there were fortunately no accidents. The rock proved to be harder to drill than any other the contractor en-

countered, and even Carset bits were dulled after making only a few feet of hole in the quartzite.

Blasting at this location had an unexpected effect on underground stratigraphic conditions. Some of the first shots, which were set off far above ground-water level, caused some twenty wells in the vicinity to go dry, apparently opening channels below that drained the reservoir supplying the wells. For some months thereafter the contractor hauled water to the homes that were affected while the drilling of newer and much deeper ones (to 140 feet) was underway. These were completed, cased and equipped with pumps, all at the expense of the Turnpike Commission, so the property owners are better off now than they were originally.

Central Penn bought the first Drillmaster seen on the northern part of the extension and used it for the bulk of the drilling. Holes were generally spaced on a 12x12-foot pattern, but ranged up to 16x16 feet and were normally put down 40 feet deep. The single machine consistently supplied muck for two power shovels. Drilling speed averaged 22½ feet an hour. A remarkable record was established there by using only five bits in drilling upwards of one million cubic yards of rock. One tractor rig equipped with Ingersoll-Rand X-71 drifter drills was also employed.

Central Penn's second section—4.07 miles long and involving 1,780,000 cubic yards of excavation—includes the Mahoning Valley Interchange built on a double cloverleaf design and calling for some deep cuts on short-radius curves for the access roads. The Drillmaster served for a short time on this contract, but most of the drilling was done with smaller equipment.

J. Robert Bazley, Inc., of Port Carbon, Pa., which, like Central Penn, has long been active in the coal-stripping business, has substantially completed one 4-mile stretch and is in the final stages of a 5.828-mile connection with the northern end of the Central Penn section. This second job, which entailed the heaviest excavation on the entire extension, necessitated the movement of 2,301,925 cubic yards of material. It included nine cuts ranging in length from 350 to 4800 feet and in depth from 15 to 170 feet. The longest one, with a maximum depth of 60 feet, required the removal of 692,560 cubic yards. This section also boasts the biggest fill in the route (1000 feet long and containing 697,000 cubic yards). Motorists traveling over it will be 160 feet above a small stream that crosses it in a box culvert 575 feet long.

To carry out this monumental earth-and-rock-shifting work Bazley assembled an imposing array of equipment including three Drillmasters for putting down either 6- or 6½-inch holes. Also



CHECKING FILL

This hydraulically operated earth-boring rig made by Sterling Engineering & Manufacturing Company was used by Turnpike engineers to sample filled areas during construction. Its auger bit can drill a 14-inch hole to a depth of 42 feet. Earth thus brought up was placed in airtight cans for laboratory examination. One important test was that of determining the moisture content by weighing samples before and after heating them above the water vaporization point. Such tests made it possible, for instance, to find out if the subbase in swampy places had been sufficiently drained before the placement of fill.



VORACIOUS EARTH MOVERS

A powerful motorized scraper-loader getting a helping shove by a bulldozer as it began to slice off a layer of earth. The size of the equipment somewhat dwarfs the drivers.

available were two other large-hole drills, six I-R wagon drills and two Hydra-Boom tractors, as well as nine shovels with dippers ranging in capacity from $\frac{3}{4}$ yard to 6 yards, nine tractors and bulldozers, 40 rear-dump Euclid trucks, six scraper-loaders, four graders, eight rollers and two truck-mounted cranes. Two fuel trucks roamed the job servicing equipment; a tire truck had a Type 30 garage-type compressor for inflating tires and a hydraulic crane for lifting them; and a grease truck carried another Type 30 for pressure lubrication. Air-operated tampers consolidated earth backfill over pipes in inaccessible places; two transit-mix trucks hauled concrete for culverts and drains; and three pneumatic machines vibrated it in the forms. The firm is doing its own surfacing and has three dual-drum Rex pavers for the purpose.

Much of the rock drilled was hard, especially a blue abrasive sandstone and an occasionally occurring conglomerate. Extremely troublesome, also, were some rounded boulders known variously as bullheads, dinosaur eggs and by other names. Geologists identify them as quartzite and hard sandstone and say they were most likely formed by the repeated twisting and shearing of the strata in which they are found—by the earth's convulsions that caused the numerous folds characterizing the mountains of the region. If dough or some other plastic material is kneaded under the palm with a rotary motion, similar shapes will be produced. These inclusions are always oriented in the same direction and athwart the direction of stratification of their host formation.

Some of the bullheads are as large as a

truck body and highly resistant to drilling, up to $3\frac{3}{4}$ hours was spent on one, and Carset bits were dulled quickly. They also defied dynamite unless penetrated by a drill hole. They are commonly covered by a thin layer of softer material, and when they happened to be

lying between drill holes in the enveloping formation the force of the blast apparently followed this film, thus failing to shatter them and usually bringing them to the top of the muck pile. In such cases, those too large for loading had to be either pushed over the bank by a bulldozer or drilled with a Jack-hammer for secondary blasting.

Although more plentiful on the Bazley job, the boulders also cropped up in some other sections. Central Penn ran into a profusion of them in one place and elected to roll them out into a field and break them up with a steel drop ball. Flying pieces chipped off in this way repeatedly broke windows in nearby power shovels, and after the glass had been replaced numerous times screens were finally substituted.

Another contractor that handled a lot of rock was Badget Mine Stripping Corporation, of Madisonville, Ky. On two sections totaling 7.3 miles in the Wilkes-Barre area it moved 2,300,000 cubic yards, about 65 percent of it rock. From one 3000-foot-long cut, called the Dale, close to a million yards was extracted. Concentrated on the attack were a 6-inch Drillmaster, four tractor boom-drill rigs and six wagon drills powered by a battery of eleven portable compressors. The Drillmaster normally put down holes 25 feet deep on 15x15-foot spacing while the smaller machines drilled mostly 14-foot holes on 5x5-foot centers.



DRESSING SLOPE

In high cuts the slopes are broken by one or more benches to prevent material from coming down later on the roadway. Wagon drills were commonly used for drilling in these areas because depths of holes could be varied readily to create even surfaces. As a final step, the slopes were smoothed off. Some contractors did this by dragging an opened-up tractor-crawler track over them by means of a tractor running along the top of the bank above. Others utilized a Gradall machine, as shown. This mobile unit has a 25-foot telescoping boom that can be shortened to 12 feet by a hydraulic piston. The boom can swing through 360 degrees, be raised or lowered from the horizontal and fitted with various digging and loading attachments.

OURS is an interdependent society and we rely strongly upon transportation to bring to us the things others have made and to send to market those that we have manufactured. Indeed, for many years shipping costs have made up a steadily growing percentage of the total price of what we buy and sell. Efforts to reduce this overhead to a minimum have resulted in many innovations in the transport methods to which we have long been accustomed. Piggybacking, palletizing of loads, etc., are some of the more dramatic changes we have seen in the last half decade. Now a new one, tentatively called "fishybacking," has been added. It is piggybacking applied to ocean-going vessels.

For years some lines have transshipped cargoes still packed in the truck-trailers in which they arrived at the docks, but by and large this procedure was unsuccessful because the old lading facilities of hoist and sling were used to place the vehicles on board. The new concept of "fishyback" is a drive on-drive off type of operation requiring specially outfitted vessels and loading equipment. About the only thing similar to it is the so-called sea-train, a ship onto which railway cars are run for over-the-water transit. In many cases, however, the latter are not self-propelled, they are bargelike craft which must be towed or pushed to their destinations.

TMT Trailer Ferry, Inc., is the leading proponent of "fishyback." Starting from scratch in 1953, the firm now has a fleet of eleven vessels, several hundred truck-trailers and a number of tractors. Its main headquarters is in Miami, Fla., and its ships operate out of Jacksonville for Puerto Rico, the Caribbean Islands, Venezuela and other major Caribbean ports. Pick-up from the consigner and delivery to the consignee are made in TMT trailers, some of which travel pig-

First Piggyback — Now Fishyback

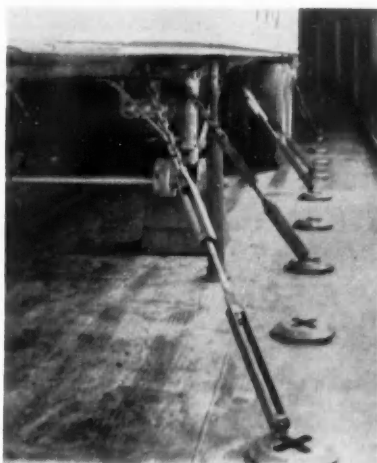
gyback as well as "over-the-road." One vessel, the TMT *Cuba*, is assigned to the tourist trade. Sailing from Key West, she carries 200 passengers to Cuba and has drive on-drive off facilities to handle 40 automobiles, thus making it literally possible to "motor" to the island.

The largest of the fleet is the *Carib Queen* which can accommodate 92 trailers, 97 automobiles and twelve passengers. A sistership, the *Florida Queen*, was recently purchased and is now being out-

fitted for fishyback service. Formerly a rail-car ferry, she will have room for 92 trailers, 20 dispatch vans, about 100 autos and twelve passengers, as well as special tanks built to hold 1000 tons of vegetable oil.

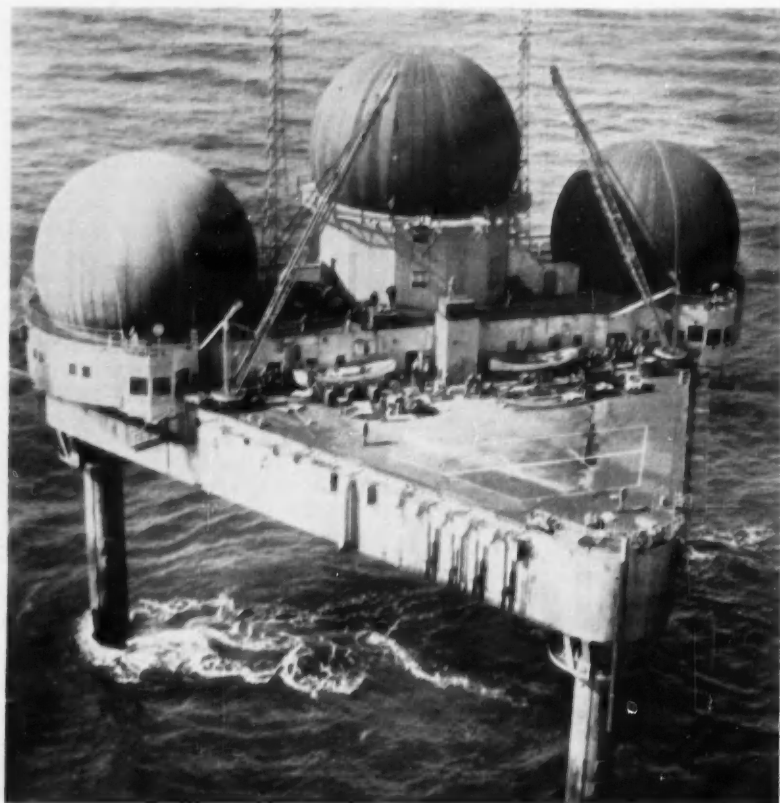
Much of the success of fishyback is due to the speed with which ships can be loaded and unloaded. A device announced only last July has further reduced the time required, and today it is possible to unload in only four hours a cargo which at one time would have taken three days to remove. Called the "Trailer-loader," it is essentially a winch-type mechanism combined with specially built-in tracks and guide rails on the vessel and a unique "dolly rabbit." Another time-saving device, also developed and patented by TMT, is a Coast Guard approved stabilizing lashing system that is easily applied yet extremely strong.

The Trailerloader has been installed on the *Carib Queen* which was launched in October and will also be used on the *Florida Queen* when it is converted next year. It is located on the lower and middle deck of the 3-deck *Carib Queen*. The third cargo deck will be reserved for automobiles, which can be driven on board under their own power over a special ramp. The *Carib Queen* makes the run from Florida to Puerto Rico in less than three days.



HOW LOADS ARE HANDLED

At the left, the Trailerloader system is pictured in an experimental hookup at TMT's Miami base. Designed by the firm's president, Eric Rath, it enables trailers to be loaded without the use of tractors. An endless cable attached to a "dolly rabbit" (under the truck's regular dolly wheels) pulls the trailer while guided by the raised rails to its assigned spot. The dolly rolls on steel tracks. Above, a Manitowoc crane on a "carryall" trailer is being unloaded from the TMT "Georgia." A special lashing device for mooring a trailer to the deck of a vessel in transit is shown at the top. Easily applied by means of slip-in swivel fittings, chains and jacks, it has been approved by the U. S. Coast Guard.



EYES AND EARS FOR DEFENSE

The steel island is based on a design originated by Col. L. B. DeLong, head of a New York construction company. The idea has been applied to various structures, including docks in South America and the Arctic, in addition to platforms from which offshore oil wells are drilled in the Gulf of Mexico. The station pictured proved its stability some months ago by surviving winds of hurricane force without damage.

Steel 'Island' Is Radar Outpost

THE Navy's 2-story triangular steel island 110 miles east of Cape Cod is now operating as America's first radar sentinel-at-sea. It is shown in its nearly completed stage with three great inflated rubber "Radomes" in which long-range radar equipment is installed.

Called "Texas Tower," the structure was so named because of its resemblance to the big oil-well drilling barges at work off the Texas coast in the Gulf of Mexico. Measuring 200 feet on each side of the triangle, it contains air-conditioned quarters for an Air Force personnel of 50 or so who will operate the radar warning equipment. Its massive proportions are indicated by the relatively small size of the men and boats. The deck provides landing space for helicopters and has two large cranes for handling supplies and equipment.

The entire structure, which was built by Bethlehem Steel Company, is mount-

ed on three steel legs, 10 feet in diameter, filled with concrete and extending 48 feet into the hard-packed sandy ocean floor. The corrosive action of sea water on the piers is minimized by what is known as counterelectrolysis, a cathodic method of protection by which a 9-inch ball weighing several hundred pounds and connected to a single conductor cable is lowered into the water by means of a motor-driven automatic reel manufactured by Gleason Reel Corporation, of Mayville, Wis. This serves to supply continuous low-voltage direct current, causing a reversal of polarity and making the area cathodic instead of anodic, thus eliminating loss of metal.

Other similar radar stations are being planned for the protection of our coastline. Two more now under construction are to be installed off Nantucket and New York.

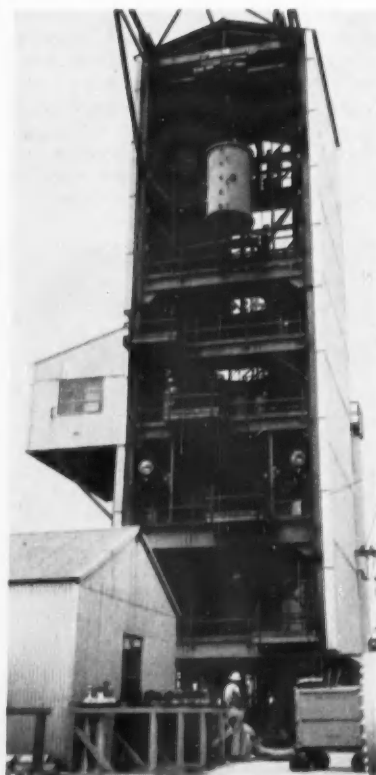
Air Replaces Oil

NOT a drop of oil passes through the newest and largest petroleum-refining pilot plant operated by the Esso Research & Engineering Company in Linden, N. J. The 5-story-high unit was built to supplement the company's laboratory-scaled investigations of the fluidized-solids technique of making gasoline.

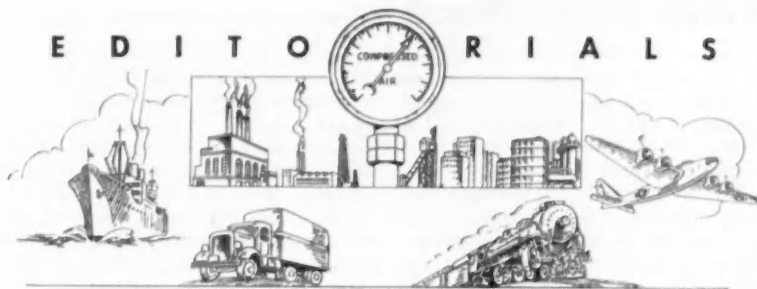
Instead of oil, compressed air flows through the refinery's king-sized reactor (45 feet high, 5 feet in diameter) at a rate of 8000 cfm. The air, sometimes tinged with trace quantities of helium, serves adequately as a substitute for oil feed stocks because the unit is aimed specifically at engineering rather than process research. The powdered catalyst in the fluidized bed is the same as that used in commercial refining plants.

The reactor is in six 2-ton sections, any number of which can be removed to allow engineers to make experimental changes inside the vessel. A 5-ton crane mounted on top is used to lift the sections in and out of position. The picture shows one being hoisted. More than 200 stoppered "port-holes" stud the reactor. Through them samples of air can be withdrawn for analysis while the plant is "on stream."

The installation includes a made-to-order, air-operated diaphragm valve that is said to be the strongest ever constructed.



EDITORIALS



LEARNING BY DOING

THE hero of the typical old-line business success story usually started out as a mere lad carrying newspapers or running errands and then doggedly fought his way up the ladder the hard way. He practically never went through college in leisurely comfort and then stepped into a going concern bought for him by a wealthy and indulgent aunt. The second formula would probably produce profits quicker than the first, but it wouldn't make very exciting reading.

In real life, operating a business of any kind is a considerable gamble filled with problems that can best be solved by one who has met them before. There is no substitute for know-how, but acquiring it by formula No. 1 is a bit tedious, tiring and time-consuming. Nonetheless, it is commonly the necessary procedure, because rarely does the boy who wants to launch a business career have a rich aunt to foot the bill for qualified help. Fortunately, there is an inexpensive way of acquiring some valuable experience early in the game. It operates under the name of Junior Achievement and describes itself as "a nation-wide educational organization which offers young people of high-school age the opportunity to gain valuable and practical prebusiness experience by organizing and running their own small businesses with the guidance of volunteer advisers from business and industry."

Under this plan, fifteen to twenty boys and girls recruited from public, private and parochial high schools form a company. A "workshop" or factory is provided for them by the local Junior Achievement, which is made up of civic, educational and business leaders. The group appoints its own board of directors, officers, labor force and sales staff and carries on under the guidance of three advisers from local concerns. These "companies" are organized in September and October and dissolved the following May, near the end of the school term.

At the outset the students decide what they want to make and sell and determine how much money they will need to get started. They raise the funds by selling capital stock (at 50 cents a share) to parents, friends, teachers and others. No one can own more than five shares, and every member of the firm must hold

at least one share. The average capitalization is about \$100. A bank account is then opened and raw materials are purchased. The company pays rent (usually \$3 a month), buys the small tools it needs and leases any machinery required from the JA organization.

Products are sold on the open, competitive market. Gross annual sales average \$300. Wages of production workers and salesmen's commissions are determined by members of the group. Complete books are kept and full reports are made to stockholders. When operations cease in May debts are paid and the inventory is sold. If the venture has been profitable, and most of them are, the stockholders get their money back plus a liquidating dividend. If there is a deficit, the assets are distributed among the stockholders.

A wide range of products is manufactured and includes jewelry, toys, building blocks, candlesticks, table lamps, Christmas tree stands, outdoor barbecue grills, ash trays, coasters, memo pads and wallets. Raw materials most used are wood, metal, plastics, paper, leather, textiles. Some companies do not make anything but engage instead in photography, advertising, printing, secretarial work, development of radio and TV shows and other "services."

Sometimes a concern finds it is in the wrong business—is turning out something that doesn't sell—and has to face a probable deficit or change to another product. A group in Fort Wayne, Ind., for instance, made 300 aluminum phone-book covers before testing the market for them and then discovered that a similar and better one was being distributed by the telephone company. With their capital tied up, the members really had to scratch their heads. They decided to convert the articles into covers for memo pads. By the end of the year they were leading all other Junior Achievement companies in Fort Wayne in sales and profits. Another firm made a plastic cigarette box that didn't move and wound up in the red. However, the group learned the valuable lesson that a business must always adapt itself to changing conditions.

By running a business of their own, teenagers learn to meet real-life situations. Also, they often find out what

they want to do or what they are best qualified to do later on. Intangible benefits are learning to work with others, to exercise leadership and to carry out orders.

Junior Achievement was started in Springfield, Mass., in 1919 by the late Horace A. Moses, then president of the Strathmore Paper Company, who got the idea from the already successful 4-H clubs operating in rural sections. This year the JA movement is sponsored in 158 American communities ranging from towns to the largest cities, and it is estimated that 47,000 students will form 3000 individual companies. Directing it nationally is Junior Achievement, Inc., with headquarters in New York City. Its officers include men high in the affairs of some of the nation's leading corporations.

HOOVER DAM'S BIRTHDAY

ON OCTOBER 23 the generators at Hoover Dam completed twenty years of steady power production. Although no longer the biggest concrete structure, the dam will soon lose to a Swiss dam the distinction of being the highest but will always stand out as a pioneer adventure in spectacular engineering achievement. It was rightfully considered an audacious piece of construction when it was begun, and called for record-breaking financing that could hardly be handled by one contracting concern. The solution was the banding together of half a dozen firms under the name of Six Companies Inc. There and then was born the idea of joint ventures so widely practiced in the field today.

Hoover Dam was the first bridge ever put on the rambunctious Colorado River, a stream so tempestuous that it awed early explorers and daunted the ingenuity of engineers for many years. The site of the dam was exceedingly uninviting and repressive. An early explorer of the region, Lieut. J. C. Ives, was glad to leave it in 1857, and dismissed it from his mind as "altogether valueless" and intended by Nature to be forever "unvisited and unmolested." Today Lake Mead is an oasis in the desert, a haunt of sportsmen and a stopping point of interest for hordes of tourists annually.

Many more dams will be required to harness the Colorado in its entirety, and a comprehensive program for the development of the upper reaches of the stream has been drawn up. When the river has been brought wholly under control, it will provide water for irrigating 2,600,000 acres of land, not to mention enormous additional power generation. Regardless of the extent of that construction, Hoover Dam will live long in the minds of engineers, just as Brooklyn Bridge continues to mark an epoch in structures of its kind though no longer conspicuous for size alone.

This and That

Air Rifle Pioneer

Charles H. Bennett, who manufactured air rifles for three generations of boys, died on September 17, at Plymouth, Mich., at the ripe age of 93. He had been president since 1912 of the Daisy Manufacturing Company in Plymouth where the Daisy air-and-spring rifle has been made since the 1880's. In his youth Bennett was a traveling salesman for his father's Plymouth Iron Mill Company, which built farming machinery. During that period a workman in the factory developed the rifle, and the elder Bennett, instead of trying to sell it, began giving it away as a premium to purchasers of his regular line of equipment. One of the first recipients exclaimed, "Gee, that's a daisy!" and the name stuck. The rifle grew popular, and by 1888 was in such demand that it became the factory's sole product.

Bennett was one of the first twelve investors in the Ford Motor Company. He bought 50 shares of the stock in 1904 for \$5000 and sold it in 1907 for \$35,000 after unsuccessfully opposing a change in the firm's policy. If the holdings had been retained a few years longer they would have been worth millions.

★ ★ ★

We Gain Some New Readers

An inmate of San Quentin prison in California who was studying public speaking surprised everyone by talking on the subject "Crime Does Pay." In slightly broken but well-chosen English he told how he, a foreigner with little education, had been given the opportunity through his prison sentence to attend school and prepare himself for a useful life. "I made

a mistake," he observed, "and now I'm making it pay dividends. My crime didn't bring me any money, but it did bring me knowledge. When I leave San Quentin I will never come back to it or any other prison."

This little story was taken from material on San Quentin's educational program sent us by Herman K. Spector, who is the noted penal institution's first full-time librarian. The library is the core of the schooling setup. It was started in 1852 but never had a trained librarian until Mr. Spector came on the job in 1947.

At first inmates were in charge, and the most illustrious of them seems to have been one Dick Fellows, who aspired to become one of the West's great highway robbers but got caught before he could fulfill that ambition. He was committed to the prison in 1870 and not only became librarian but at times also gave long moral speeches to the other convicts and eventually was "promoted" to the rank of teacher in the department of moral instruction at Folsom Prison. Fellows claimed he was a Harvard alumnus, and no one doubted him. Spector, on the other hand, says he is a "meager Columbia graduate," but he's doing what is described as a whale of a job. Before he came chaplains served as librarians, besides pursuing their own calling.

The library contains 25,000 volumes, and the inmates, with plenty of time on their hands, patronize it freely. Their reading preferences are shown by a tally of the types of books they withdrew last year: history, travel and biography, 12,726; practical arts and science, 10,447; literature, language and grammar, 7250; philosophy, psychology and religion, 5321; social science, 4040; fine arts, 3893. These were in addition to fictional books and magazines. With permission, 1271 men also bought 2077 books by mail for \$5753 and 637 others entered 1028 magazine subscriptions.

At the time the latest report was compiled, 1588 men were attending day and night academic classes, 149 were enrolled in vocational courses and 314 were obtaining instruction by correspondence. Many of the convicts try their hand at writing, and one of the librarian's duties is to read the manuscripts and judge whether they are worthy of being submitted for outside publication. During the year he approved 973 short stories, plays, poems, novels, biographies and feature articles and rejected 418. Two of the manuscripts were published by top national magazines. One dealt with aviation and the other with buffalos. An inmate who had been a professional writer on the outside has had two plays and two books published since his incarceration.

Included in the material we received was a copy of the *San Quentin News*, a tabloid-size newspaper now in its sixteenth year of publication. It is devoted entirely to news within the institution and has both English and Spanish columnists. The former writes under the heading, "Bastille by the Bay." To quote one of his quips, "There was not a single traffic fatality in all San Quentin over the Labor Day weekend."

The reading matter was sent us to bolster a modest request for a copy of our magazine for the library. After perusing it, we went a little farther and put the institution on our regular mailing list. We hope that it doesn't inspire any of the San Quentin residents to ask Santa Claus for a rock drill or a paving breaker.

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Fifty Years of Service

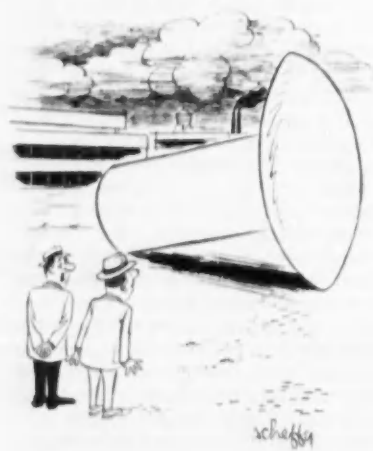
We have received from the Osaka Gas Company in Japan a booklet printed in observance of the firm's fiftieth year of service. Gauged even by American standards, this is a large enterprise. Serving Osaka, Kobe, Kyoto and adjacent areas, the utility has a property investment of \$163 million and employs 6456 persons. Its 47,184 stockholders received dividends last year from profits totaling \$3,460,000.

The first gas was produced in October 1905. During the first year 3300 customers bought it for lighting purposes—a use that was abandoned around 1910 in favor of heating when the incandescent light bulb became common. Both world wars seriously interrupted the company's growth, but steady progress has been made at other times. Consumers increased to 85,000 in 1925, to 450,000 in 1940 and to 880,000 in 1945.

By that time, however, the major cities of Japan had been bombed, damaging production and distribution facilities and reducing the number of customers to 450,000. Then a shortage of coal for making gas rendered it impossible to serve more than 170,000, and those only a few hours a day. As late as 1952 there were only 645,000 consumers, or 73 percent of the prewar total. In that year a \$41-million, 5-year expansion plan was launched and now, in its fourth year, customers are back to 800,000 and gas consumption per meter is 2.7 times that of 1937.

Total sales in 1955 were 25 billion cubic feet of gas, 614,000 tons of coke and 70 million pounds of tar products. To insure even distribution of gas throughout the cities served, high-pressure lines connect Osaka with both Kyoto and Kobe. These are the first of their kind in Japan.

With negligible oil production, Japan



"To give you an idea of the size of the project, this is one of the rivets."

relies on coal for fuel and power, but only about 18 percent of the locally mined supply is of high enough grade for carbonization and the company imported 17 percent of its coal stocks in 1955. The possibility of gasifying low-grade coal in place at the mines is now being thoroughly investigated.

★ ★ ★

Air Bubbles Will Keep Ports Open

A Swedish scheme to utilize compressed air to maintain an ice-free shipping lane in Lake Malar throughout the winter season seems to be approaching realization. It calls for keeping the water open from Vasteras, an important inland industrial city, to the Baltic port of Sodertalje. Traffic is now greatly hampered by the protracted and heavy ice formation in winter.

It is planned to lay on the lake bottom special neoprene-plastic tubing perforated at regular intervals with small holes from which the air can escape. Preliminary calculations indicate that the project will pay for itself by eliminating costly ice-breaking and by facilitating the speedy turnover of goods, thereby reducing the need for storage space.

Following several years of successful use of the air system in ferry lanes, at shipyards and timber-sorting stations, an experimental plant was set up last winter in the port of Vasteras. On the bottom was laid 1000 feet of plastic tubing with tiny holes at intervals of 33 feet in the main section and 16 feet at the end farthest from the compressor station with an installed capacity of 450 cfm. The water at that point has a maximum depth of 50 feet.

At the time the air was turned on ice covered the surface to a depth of 2 feet. After twenty hours, holes began to appear, and after 24 hours more they were 30 feet wide and there was an almost continuous lane of open water. In two weeks the path was 60-65 feet wide. It remained free as long as air was fed through the system, but a layer of ice began to form as soon as that was discontinued. As the winter was an unusually cold one it was apparent that the method was reliable under the most severe conditions that might be expected—in fact, it was found that only half of the available compressed air was needed.

Following this successful trial, a committee of fourteen engineers and economists was formed to study the Lake Malar scheme further and concluded that there was no obstacle that could not be overcome. A fishing expert gave assurance that the introduction of air would most likely benefit marine life and that fish would probably be plentiful in the open lane.

Although reports from Sweden credit

the idea to a Swedish industrial firm, compressed air has been employed in a similar manner for many years in America to maintain open water in front of gates on hydroelectric dams. The first large-scale installation was made in the winter of 1916-17 at the Mississippi Power Company's dam across the Mississippi River at Keokuk, Iowa and was designed to relieve pressure of thick ice against the 119 control gates surmounting the spillway section. The operation was described in detail in our January 1923 issue.

Subsequently, air was used in various lakes to keep them ice-free for the accommodation of migratory water fowl. In the winter of 1950-51, Brown's Tie & Lumber Company adopted the idea to maintain open water in its log pond at McCall, Idaho, and numerous sawmills in northern latitudes of both the United States and Canada have adopted the method. Formerly the plants closed during certain periods every winter.

The explanation of the action of the air is simple. Fresh water is densest and hence heaviest at 39°F, and when it reaches that temperature it sinks. The air bubbles lighten this lower layer, which rises to the top and displaces colder water that then seeks the bottom. Thus circulation is set up and prevents the surface water from ever reaching freezing temperature. The development of plastic pipe has simplified installation and is, in fact, an important consideration in the proposed Swedish plan.

Clarke Now Consultant

Charles W. E. Clarke, who retired last June from United Engineers & Constructors, Inc., Philadelphia, Pa., is now an engineering consultant with headquarters in Narbeth, Pa., where he lives. For almost 50 years he was concerned with the design, construction and operation of numerous installations for public utilities and large industrial organizations, including steel mills. He started his career in 1910 with Stone & Webster Engineering Corporation in Boston, Mass., and later was identified with Dwight P. Robinson Company, which merged with other concerns in 1928 to form United Engineers & Constructors. When he retired from that firm he was vice-president, consulting engineer and a member of the board of directors. He retains the latter connection.



"Do you mind? My feet are like ice."

Compression Distillation of Sea Water

In 1852, Scottish physicist William Thomson, who was later to be known as Lord Kelvin, proposed using

the heat pump to remove salt from sea water. Subsequently many other inventors worked on the idea, which is now known as compression distillation. Among them was Addison G. Waterhouse, who received a patent on the process but never went any farther. Not until 1941 was a satisfactory apparatus developed for the service. It was created largely through the efforts of Arthur D. Little, Inc., and was used extensively by the U.S. Navy during World War II. The units, made by E.B. Badger & Sons Company, of Boston, Mass., were described in our March 1946 issue.

Since then compression distillation has been widely accepted. A recent example of its application is found in four new \$7,500,000 supertankers built by Sun Shipbuilding & Dry Dock Company for Sun Oil Company. Each vessel has two identical distillers, each capable of providing 200 gallons of distilled water per hour. One unit normally supplies the tanker's needs; the second one is held in reserve. The water is used for boiler feed, washing, cooking and bathing.

Sea water is pumped directly from the ocean into a still, and live steam from an auxiliary source is fed to an evaporator to start the cycle of operations. Thereafter, steam from the boiling sea water is compressed and recirculated, thus returning the latent heat of evaporation plus some heat added through the work of compression. The steam enters a compressor at slightly above atmospheric pressure and is discharged at from 3 to 5 psi. The only outside heat needed is a small amount of make-up steam, and energy is required to operate the compressor driven by a 30-hp motor.

New Pipe-Cleaning Tool



PIPE-CLEANING SYSTEM

Depending upon the diameter of the pipe to be cleaned, the Torno-Blast varies somewhat in construction. Shown at the top is the largest size, the Model 100 for 4- to 12-inch pipe, consisting mainly (left to right) of a baffle with an extension rod, a conical diverter, a body with roller guides, a nozzle and an adapter. There are three other styles for reclaiming tubes and pipes from $\frac{1}{2}$ to $\frac{3}{4}$ inch, $\frac{7}{8}$ to $1\frac{1}{2}$ inches, and 2 to $3\frac{1}{2}$ inches, respectively. The worker at the left is removing heavy incrustations of carbon from short lengths of pipe.

INDUSTRY can save a lot of money annually, says the J. C. Fennelly Company, if it will reclaim instead of discard pipes and tubes that have become useless because of rust or heavy incrustations of carbon, cement or other deposits that retard or obstruct the flow of fluids. The concern has introduced pneumatic equipment that cleans the inner surfaces as it is pushed through, doing so thorough a job, it is claimed, that the metal "gleams like new." It goes by the name of Torno-Blast and is a modified sandblast outfit except that the abrasives used range from peach- and cherry-pit and walnut shells, ground corncobs and rice hulls to sand, quartz, garnet, cut steel wire, crushed steel shot, refractory slag and rock-wool and other products, whichever best meets the needs of soft aluminum-alloy tubes, heavy cast-iron pipe or the toughest armor plate.

The work is performed without rotating either the tool or the pipe, but the abrasive issuing from the nozzle is directed under varying pressure against a conical diverter that causes the particles to whirl and to scour the surface as the operator moves the assembly forward by aid of a stiffening rod. Mobile or semiportable compressors with a rated capacity up to 110 psi are recommended, and air consumption is said to range from 22 to 502 cfm, depending upon the nozzle aperture and the abrasive.

To determine the effectiveness of the Torno-Blast system as compared with wire brushing, a large West Coast utility made large-scale tests of the biggest model on welded steel gas pipe. The latter had an inside diameter of 10 inches and varied in length from 25 to 44 feet. It was stacked outdoors and had an inner

coating of rust from $\frac{1}{64}$ to $\frac{1}{32}$ inch thick. Different abrasives were tried and forced through 50 feet of 1-inch hose to the nozzle with air at 95-100 psi.

According to the findings, it was concluded that the best all-around results were obtained with mineral shot because it is dust-free, reusable (about 25 to 30 percent make-up is required) and removes the rust quicker than sand. It was further stated that the tool did a satisfactory job of cleaning the 10-inch

pipe when it was advanced at an average speed of 1 foot per second. With a 4-man crew—operator, two helpers and the compressor man—this means 9600 feet in an 8-hour day, including setup time, reclaiming abrasive, blowing out pipe after blasting and repositioning. The over-all cost, as given in the utility's field notes, is in favor of the new method—0.0173 cents per foot as against 0.0355 for wire brushing.

Circle 1E on reply card

New Technique for Vacuum-Furnace Control

AN INLET adapter designed especially to work at pressures of about one micron absolute up to atmospheric has made it possible to use a standard



MASS SPECTROMETER

Analyses of off-gases from the vacuum furnace partly shown at lower-left are being checked on a tape recorder. The inlet adapter is at the right of the spectrometer.

mass spectrometer to analyze off-gases discharged from vacuum furnaces and thus assure closer control over vacuum-melting processes. As chemical reactions in the melting metal progress, different mixtures of gases are given off and these are analyzed by the mass spectrometer, thus indicating the condition of the melt. Premature pouring is undesirable because some impurities would still be in the final product. (See *Better Metals from Vacuum Metallurgy* published in the March 1956 issue of this magazine.) "Overcooking" the melt can be bad, too, because some of the alloying ingredients used may be of low volatility and might be driven off as well.

The accompanying illustration of a Type 21-610 Mass Spectrometer manufactured by Consolidated Electrodynamics Corporation shows it with an installation connected to a 1000-pound vacuum furnace in General Electric's Carbonyl Department. Valves admitting gas samples to the instrument are manually operated in this case, but the unit may be equipped for automatic control.

Circle 2E on reply card

Industrial Notes

What is described to be the only battery-powered industrial sweeper that can work an 8-hour shift without recharging has been introduced by the Wayne Manufacturing Company. The vehicle has two motors: one to power it and the other to operate the brooms and dust-control system. It also features a built-in charger that can be plugged into any 110-volt outlet. In addition to a 36-inch pickup broom, the unit can be equipped



with a broom on either or both sides to increase the sweeping swath to 60 inches and to permit close cleanup in any direction. Dust is collected in a large hopper (bags are not used) that is emptied hydraulically without the driver leaving his seat. The Model 605-E is designed primarily for large industrial plants where quiet and fume-free service is required and is also recommended for supermarkets, department stores and air and railway terminals. It is said to cover 70,000 square feet of open area per hour.

Circle 3E on reply card

Epoxy resins with their outstanding properties for bonding metals, wood, plastics, glass and ceramics are now being offered by Houghton Laboratories, Inc., in a kit convenient for use in the field. It provides two tubes containing preweighed, preproportioned amounts of resin and hardener. When needed for patching or repairing laminated plastics,



epoxy castings or electrical and other industrial products, beads of equal length are squeezed from the tubes onto a palette. After thorough mixing the adhesive is ready for service.

Circle 4E on reply card

Because many generating stations in Britain have changed over from grate-firing to pulverized-fuel furnaces, an effort is being made to overcome the shortage of cinders for aggregates. The problem seems to have been answered by the Building Research Station of Great Britain which has succeeded in processing flyash, of which large quantities are available. It is converting the raw material, together with water, in a rotary pelletizer and sintering the product in a rotary kiln. No fuel cost is involved in the operation of the latter because the flyash contains some 5 percent of unconsumed carbon. One company is planning to turn out 60,000 tons of aggregates by the method.

A shop-made vibrating screen provided with a Cleveland air vibrator is being used with success by R. Krasberg & Sons Manufacturing Company to remove slugs and chips from precision stampings. Sorting and cleaning them

was a time-consuming hand job until Charles Bartz, plant superintendent, developed the table, which consists of a screen that fits loosely in a framework mounted on eight coil springs and that can be easily removed to allow the use of screens of other sizes. The table measures 40x40x36 inches over-all and has a



hopper bottom that dumps the slugs directly into a scrap box. Plans for it are available. The device is said to save the plant 60 man-hours a week.

Circle 5E on reply card

What is described as a new and unique line of safety shut-off solenoid valves has been announced by Automatic Switch Company. Of the manual-reset type,



Presenting another **NEW**

WISCONSIN

HEAVY-DUTY

Air-Cooled

ENGINE

the **FULL-POWERED**

V-type 4-Cylinder 30 hp. Model VH4



This rugged new engine has been added to the Wisconsin line to fill the horsepower gap between the Model VF4 25 hp. and the Model VG4D 36 hp. Wisconsin Engines. At the same time, the mounting base is dimensionally identical to the Models VE4 and VF4 to permit convenient replacement of the latter engines if greater power is required.

The Model VH4, which now makes its bow for the first time, is the most powerful engine of its type and size available today, in our estimation. It is an engine of basic High Torque design which gives it the important advantage of being able to deliver maximum usable *Lugging Power* that carries the load through the hard, heavy pulls. It has been designed to give you the best possible performance at all engine speeds from 1400 to 2800 rpm., even when operating under intermittent shock-loads or under constant load, continuous service. It is an exceptionally smooth-running, even-firing engine and has all the traditional heavy-duty features that characterize all Wisconsin Models, from 3 to 36 hp. — built for hard service at all temperatures up to 140° F.

Learn more about this new engine. Write for Bulletin S-196 for detailed data and engineering specifications. Also ask for Service Map Bulletin, Form S-198.



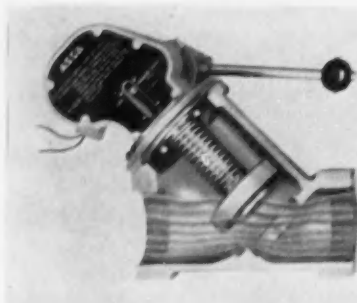
WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

Circle 12A on reply card

A 6052-V₂



they are designed to control the flow of manufactured, natural and LP gases and can also be utilized to handle varying grades of fuel oil and noncorrosive liquids and gases. They are available in

sizes ranging from $\frac{3}{4}$ to 6 inches, and pressures from 25 to 100 psi. The $\frac{1}{4}$ -to 3-inch valves are designed for use in gas supply lines leading to boilers, furnaces, ovens and other heating equipment and automatically shut off the fuel as soon as power fails. They meet the requirements for such valves (gas) in safety codes. Approvals on other sizes and services are pending. The assembly consists of two basic parts—valve operator and valve body, and a visual indicator shows whether the unit is in open or closed position. Optional equipment includes a switch for alarm or electric signaling, explosion-proof or water tight solenoid enclosures and a time delay to guard against momentary loss of power.

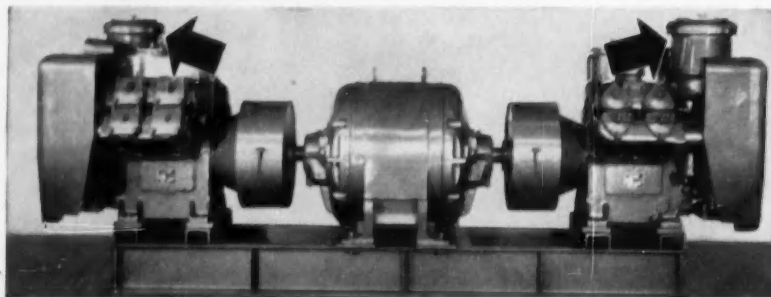
Circle 6E on reply card

Whether you break ground or production bottlenecks

Air-Maze filters will keep your compressors on the go!



Breaks Ground for highway repair. This calls for dirt-free air to protect precision parts of portable tools and compressor cylinders against premature wearing and scoring. So to assure operating dependability, cut downtime and engine overhaul, contractors rely on Air-Maze filters to scrub dirt-laden intake air completely clean in a bath of oil.



Breaks Production Bottlenecks. This manufacturer insures continuous, trouble-free operation of automatic production machinery by using only filtered air in control systems. Erratic operation and production breakdowns are avoided because Air-Maze oil bath filters keep airborne dirt from close fitting pistons, valves and control components.

AIR-MAZE The Filter Engineers

AIR FILTERS • SILENCERS • SPARK ARRESTERS • LIQUID FILTERS • OIL SEPARATORS • GREASE FILTERS

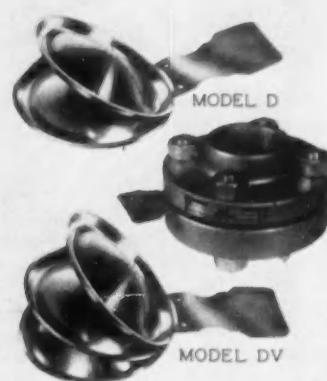
25000 Miles Road • Cleveland 28, Ohio

Circle 13A on reply card

Dressed in one-piece pressurized garments with zipped-on gloves, men can work with safety in areas exposed to harmful gases and chemicals. The suit is provided with a quick-connect coupling for an air hose and is inflated with just enough air so that the pressure inside slightly exceeds that on the outside, thus effectually preventing liquids and fumes from entering. The emergency garment is made by Standard Safety Equipment Company of different fabrics to meet service requirements.

Circle 7E on reply card

For process equipment that operates under pressures, temperatures and corrosive conditions too severe for conventional rupture disks, Black, Sivalls & Bryson, Inc., has announced two new types—the Model D for systems that function under continuous positive pressure and the DV for service under periodic or continuous vacuum. The former is composed of two matched prebunched

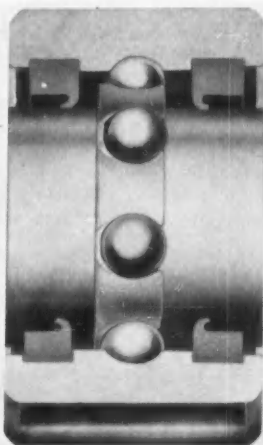


disks assembled as a unit for installation in a BS&B safety head. The upper disk is slotted and the lower one provides the pressure seal. The Type DV has a third member or vacuum support on the process side to prevent collapse or reversal of the sealing disk. Both are available in sizes from 1 inch through 36 inches, in a pressure range up to 1000 psi and in a wide choice of materials.

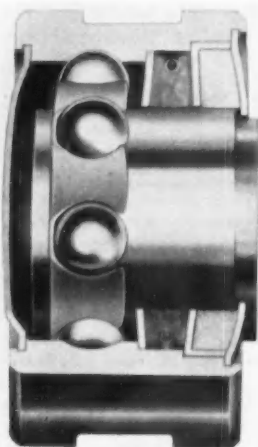
Circle 8E on reply card

Iodine, an antiseptic that has been applied successfully for more than three years in one of New York City's big hospitals, is now available for industrial first-aid use in 1-ounce bottles and in the form of swabs and applicators for field kits. The two latter contain an anti-freeze component. According to Davis Emergency Equipment Company, the exclusive industrial distributor, the preparation does not sting, stain or burn even when bandaged, is noninjurious when swallowed accidentally and is a superior bactericide. The brown film gives protection as long as the color lasts.

Circle 9E on reply card



Ball bearings made specifically to reduce friction in belt-conveyor rolls have been announced by Marlin-Rockwell Corporation. There are types for in-board and outboard mounting and with varying seals to keep grease in and dirt out. Two styles are shown: the inboard Conv-3-J at the top is mounted directly in the roller and has positive-contact, oil-resistant seals of synthetic rubber;



the Conv-3-SF has milled slots in the outer ring that fit into U-shaped brackets in the conveyor frame for outboard mounting. This model has a metal shield backed by impregnated felt and a spring-controlled cork seal. Both bearings are lubricated for life, and all exposed surfaces are cadmium plated to resist corrosion. *Circle 10E on reply card*

A continuously running cam drive and unique air-powered ejector mechanisms are features of a 12-station machine that is said to weld together 2-piece automotive-hood hinge stampings with nine spot welds at the rate of 1200 per hour. The drive controls indexing and sequence timing of the welds, which are made when the 5-rpm cam is in the dwell posi-



INGERSOLL-RAND GYRO-FLO 105 COMPRESSOR POWERED BY CONTINENTAL RED SEAL, SUPPLYING AIR FOR PAVING BREAKER CUTTING OFF CONCRETE PILING

Year after year, ever since 1902, Continental engines have been proving their dependability in a steadily-lengthening list of special-purpose machines. Today, no matter what the exact requirement of the job, there's a Red Seal model—gasoline, Diesel, or LPG—engineered and built to meet it down to the last detail—a model with the proper performance characteristics, profile, shape and weight. In the industrial line there are models at closely-spaced levels—from 14 to 240 horsepower. You find Red Seals in many types of construction and industrial equipment, in farm machines of all descriptions, and in transportation, speeding the job and proving their inbuilt qualities of performance, economy and long life.

SERVICE AND GENUINE RED SEAL PARTS
SOLD EVERYWHERE

GASOLINE AND LPG ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Base Engine H.P.
N56	4	2 1/4	3 1/2	56	14.4 @ 2200 RPM
N62	4	2 1/2	3 1/2	62	15.3 @ 2200 RPM
Y69	4	2 1/2	3 1/2	69	21.4 @ 2400 RPM
Y91	4	2 1/2	3 1/2	91	28.5 @ 2400 RPM
Y112	4	3 1/8	3 1/2	112	32.0 @ 2400 RPM
F124	4	3	4 1/2	124	36.5 @ 2400 RPM
F140	4	3 1/8	4 1/2	140	42.0 @ 2400 RPM
F162	4	3 1/8	4 1/2	162	49.0 @ 2400 RPM
F186	6	3	4 1/2	186	60.5 @ 2400 RPM
F209	6	3 1/8	4 1/2	209	68.0 @ 2400 RPM
F226	6	3 1/8	4 1/2	226	73.0 @ 2400 RPM
F244	6	3 1/8	4 1/2	244	79.0 @ 2400 RPM
M271	6	3 1/8	4 1/2	271	86.2 @ 2400 RPM
M290	6	3 1/8	4 1/2	290	92.2 @ 2400 RPM
M330	6	4	4 1/2	330	104.4 @ 2400 RPM
M363	6	4	4 1/2	363	128.9 @ 2400 RPM
B371	6	4 1/8	4 1/2	371	110.0 @ 2400 RPM
B427	6	4 1/8	4 1/2	427	127.0 @ 2400 RPM
G134	4	3 1/2	4 1/2	134	34.2 @ 2000 RPM
G157	4	3 1/2	4 1/2	157	40.0 @ 2000 RPM
E201	4	3 1/2	4 1/2	201	65.4 @ 2400 RPM
H227	4	3 1/2	5 1/2	227	54.0 @ 1800 RPM
H243	4	3 1/2	5 1/2	243	57.9 @ 1800 RPM
H260	4	3 1/2	5 1/2	260	62.0 @ 1800 RPM
H277	4	4	5 1/2	277	66.4 @ 1800 RPM
K363	6	4	4 1/2	363	123.0 @ 2400 RPM
J382	4	4 1/8	6	382	74.0 @ 1400 RPM
T371	6	4 1/8	4 1/2	371	119.0 @ 2400 RPM
T427	6	4 1/8	4 1/2	427	140.0 @ 2400 RPM
U501	6	4 1/8	5 1/2	501	159.0 @ 2400 RPM
R513	6	4 1/8	5 1/2	513	164.3 @ 2400 RPM
R572	6	4 1/8	5 1/2	572	182.4 @ 2400 RPM
R602	6	4 1/8	5 1/2	602	191.7 @ 2400 RPM
V603	8	4 1/8	4 1/2	603	220.0 @ 2800 RPM
S749	6	5 1/8	5 1/2	749	217.0 @ 2200 RPM
S820	6	5 1/8	5 1/2	820	237.0 @ 2200 RPM

CUSHIONED POWER DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Base Engine H.P.
ZD129	4	3 1/4	3 1/2	129	34.0 @ 2000 RPM
GD157	4	3 1/4	4 1/2	157	39.0 @ 2000 RPM
*E201	4	3 1/2	4 1/2	201	45.0 @ 2000 RPM
HD243	4	3 1/2	5 1/2	243	55.0 @ 2000 RPM
*HD260	4	3 1/2	5 1/2	260	59.0 @ 2000 RPM
*HD277	4	4	5 1/2	277	63.2 @ 2200 RPM
*JD382	4	4 1/8	6	382	72.5 @ 1600 RPM
TD427	6	4 1/8	4 1/2	427	106.0 @ 2000 RPM
RD572	6	4 1/8	5 1/2	572	154.0 @ 2000 RPM
VD603	8	4 1/8	4 1/2	603	175.0 @ 2600 RPM
SD802	6	5 1/8	5 1/2	802	202.0 @ 1800 RPM

*Available for industrial applications only.



Continental Motors Corporation

MUSKEGON • MICHIGAN

8 EAST 4TH ST., NEWYORK 17, NEWYORK • 3817 S. SANTA FE AVE., LOS ANGELES 10, CALIF.
6210 CEDAR SPRINGS ROAD, DALLAS 9 TEXAS • 1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GA.

Circle 11A on reply card

NUGENT LUBRICATING SPECIALTIES LET YOU SEE WHAT'S GOING ON!

- **SIGHT FEED VALVES** provide a means of regulating and visually checking oil flow at the point of delivery to bearings, gears, etc.
- **SIGHT FLOW INDICATORS** tell you at a glance, or by the sound of an alarm bell, whether or not oil is flowing properly to vital parts.
- **MULTIPLE OILERS** are furnished in a variety of types with any number of feeds and will materially reduce lubrication costs for machinery with many enclosed or hard-to-get-at bearings.

Nugent manufactures a complete line of lubricating specialties. Write for descriptive literature mentioning the type of equipment you are interested in.

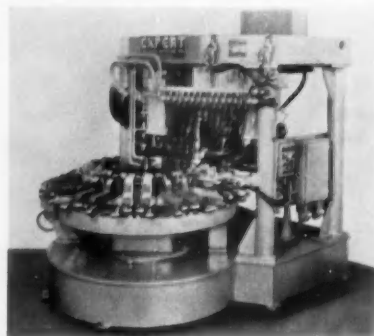


Wm. W. Nugent & Co., Inc.
3434 Cleveland St. SKOKIE, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

Representatives in Boston • Cincinnati • Detroit • Houston • Los Angeles • Minneapolis • New Orleans • New York • Philadelphia • Portland, Ore. • San Francisco • Seattle • St. Louis • Tulsa • Representatives in Canada: Montreal • Toronto • Vancouver

tion. The ejectors separate right- from left-hand stampings, both of which are welded in adjacent fixtures on the 6-foot diameter table, and deposit each kind on its own conveyor. The workpieces are manually loaded into 24 fixtures as the latter arrive in front of the operator and are firmly held in position by stationary pneumatic clamps at the weld stations, of which there are four. The welding



guns are suspended from an upper platform supported by tubular steel columns and are operated by hydraulic power supplied by a motorized hydraulic pump with tank unit which is an integral part of the machine. The working cycle is automatic. The welder was built by Expert Welding Machine Company.

Circle 11E on reply card

Profile and detail drawings of screws, screw heads and threads, which appear in profusion on nearly every plan or design, can now be traced in minutes by use of a 4-piece template kit made of rigid, transparent vinylite. The one for small machine screws covers flat, oval, round, binding and fillister types from $\frac{1}{16}$ inch to No. 6; that for screw heads provides for top and side elevations of hex and square heads; and the screw-thread template includes American Standard threads from 20 to 4 per inch, $\frac{1}{4}$ inch to 4 inches in diameter. All have needle-sharp centering guides and well-defined apertures.



Circle 12E on reply card

For use on all types of diesel and gasoline engines, air compressors, hydraulic equipment, machine-shop coolant systems and elsewhere where oil must be efficiently cooled in a compact unit, Heat-X, Inc., has introduced a line of coolers—the WIO—for operating pressures up to 250 psi and temperatures to 300°F. The units have a brass shell and copper tubes and feature a patented inner-fin construction that is said to permit more cooling in less space than is normally possible.

Circle 13E on reply card

An air or gas vane-type flowmeter designed for a constant pressure drop across the meter is being offered by the Instrument Division of Scully-Jones & Company for applications including indicating, controlling, alarm signaling, sequence starting, shutdown, etc. Of the dry type and calibrated against gravity, the No. 1050 is available in three standard body sizes with scale diameters of 4½ and 6 inches. Readable and calibrated accuracy is said to be ½ of 1 percent and from 2 to 5 percent, respec-



tively, depending upon scale range and diameter. For scale ranges up to 50 cfm, all the gas passes through the instrument, making it virtually independent of pipe restrictions and elbows; but for a flow in excess of 50 cfm the meter is connected in shunt (as shown in illustration) in one of several arrangements. Calibration for densities of different gases is corrected by simple adjustments.

Circle 14E on reply card

Serious accidents, costly damage to electrical equipment and work spoilage can be averted, it is claimed, by a simple safety device conceived by Dayton Rogers Manufacturing Company, 2824 Thirteenth Avenue, Minneapolis 7, Minn. Called the Multiple Lock-Out, it locks a switch on a power line or source such as a fuse box in such a way that one member of a maintenance or repair crew cannot throw it while others are busy elsewhere on the line or machinery. The new device is provided with a number of

VICTAULIC®



METHOD OF PIPING

VICTAULIC HAS EVERYTHING...



VICTAULIC COUPLINGS

Simple, fast, reliable. Styles 77, 77-D, for standard uses with steel or spiral pipe, — Style 75 for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¼" to 60".



ROUST-A-BOUT COUPLINGS

For plain or beveled end pipe Style 99. Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 8".



VICTAULIC SNAP-JOINTS

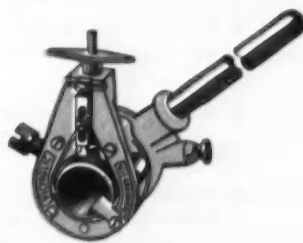
The new, boltless, speed coupling, Style 78. Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

COUPLINGS FOR EVERY PIPING JOB



VICTAULIC FULL-FLOW FITTINGS

Elbows, Tees, Reducers, Laterals, a complete line—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¼" to 12".



VIC-GROOVER TOOLS

Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes ¼" to 8".

PLUS FITTINGS AND GROOVING TOOLS

"EASIEST WAY TO MAKE ENDS MEET"

Promptly available from distributor stocks coast to coast.
Write for NEW Victaulic Catalog-Manual No. 55-B-11

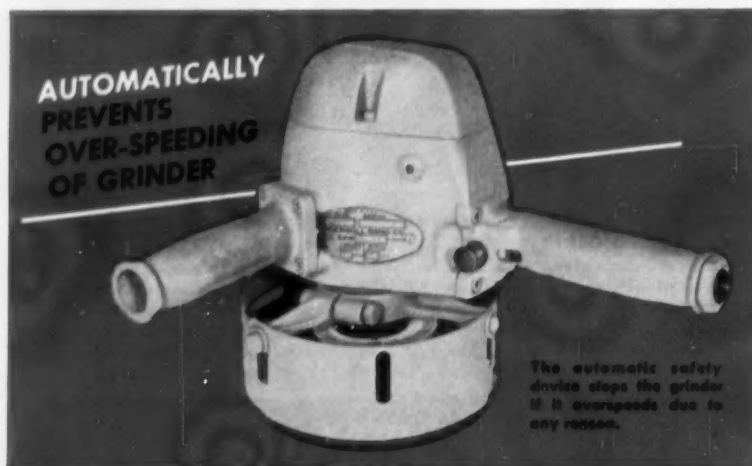
VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.

Circle 16A on reply card

NEW

THE ONLY

SURFACE GRINDER with a POSITIVE SAFETY SHUT-OFF!



PLUS THESE OTHER COST-SAVING OPERATING ADVANTAGES:

- Handles can be set at 90° or 120° for close corner work and operator comfort... another Ingersoll-Rand FIRST!
- A responsive governor insures maximum cutting speed and minimum air consumption regardless of load.
- Single point lubrication, double-sealed wheel bearings, large oil reservoir for long life, low cost operation.
- Top of tool is flat for easy pressure application.
- Available in 2 Models and 4 speeds as follows:
 Speeds: 3100—4100—4500—and 6000 rpm.
 Size 41F with push-locking throttle for constant operation.
 Size 41FX with self-closing, safety type throttle.

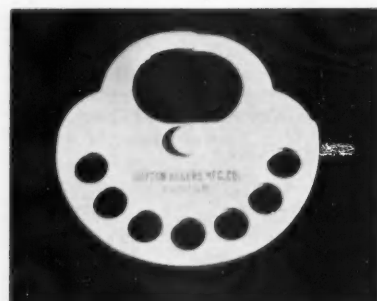
Ask for a demonstration of this new safety grinder in your shop.

8-343

Ingersoll-Rand

11 Broadway, New York 4, N.Y.

Circle 17A on reply card

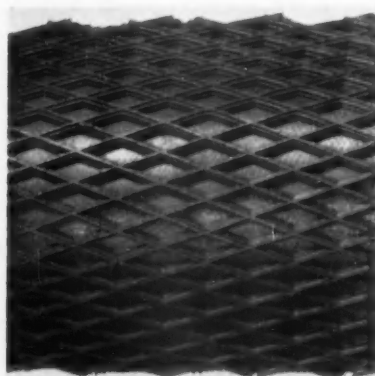


holes, and each man on a given job receives a padlock with key that he inserts in one of the holes to lock out the line. In other words there are as many locks as there are workers. Not until the last one has opened and removed his lock is it possible to throw the switch and clear the line. The gadget is made of case-hardened and plated strip steel and is being put on the market by the company. List price, \$1 each, \$10.80 per dozen.

A soldering iron no larger than a pencil and weighing only an ounce is being made by the Wall Manufacturing Company. It is 7½ inches long, has a ⅛-inch tip and operates on 110-120 volt a-c or d-c current. The little tool embodies the company's "thermostatic brain" that controls the heat so that fusing and tip-burning are prevented. A special feature keeps the handle cool.

Circle 15E on reply card

Wedge-Grip is the name of a new conveyor-belt material of "3-deck" pattern that enables it to carry packages from cans to rough cloth bags as well as certain kinds of smooth, hard bundles on inclines up to 30-35 and 45°, respectively. A product of Goodyear Tire & Rubber



Company, it is made of a soft but abrasion-resistant rubber compound and has cross-crossing ribs of step-down design that form small, open-center diamonds so that as one step is worn down another one is presented. The ribs are sliced at regular intervals to provide gripping fingers that adjust themselves to uneven surfaces.

Circle 16E on reply card

Books and Industrial Literature

A Study of Magnesium Fire Extinguishing Agents is the title of a report (PB 121375) written by L. M. Greenstein and S. I. Richman, Francis Earle Laboratories, Inc., for the U. S. Air Force. Of 149 pages, it deals with tests which have proved that chlorobromomethane combined with a 50 percent solution of the liquids diisodecyl phthalate or ethanol is the most effective agent for extinguishing magnesium fires. Chlorobromomethane alone is not satisfactory, but it reduces the intensity of the secondary fire and inhibits combustion by forming a protective film on the metal. But when combined with boron trifluoride, boron trichloride, magnesium bromide or calcium bromide its efficiency as an agent is increased. Published by the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Price, \$3.75.

The Associated General Contractors of America, Inc., has announced that the *Foreword to the Contractors' Equipment Ownership Expense Manual* has been revised by eliminating duplicate headings and listings and by adding an alphabetical cross-reference of listings as well as new items of equipment. The manual is a compilation of the average cost of owning and maintaining construction equipment and may be purchased from the AGC national office, 1227 Munsey Building, Washington 4, D. C. Price, \$1.00.

Bulletin GEA-6317, an illustrated General Electric Company publication, describes application features of control devices built to meet Joint Industry Conference (JIC) standards. Product data are given on magnetic starters, relays, oil-tight push buttons, solenoids, limit and plugging switches and on a pneumatic time-delay relay. *Circle 17E on reply card*

R. P. Adams Company, Inc., is offering a 10-page bulletin (No. 909) which shows by means of cut-away sections and drawings the functioning of its automatic water filters. Dimension charts and flow curves are given for all three sizes of filters and for Poro-Stone, Poro-Screen and Poro-Edge elements. *Circle 18E on reply card*

A one-page catalogue sheet illustrating and describing its new polyethylene pillows that are said to reduce evaporation of liquids in open vessels as much as 70 percent is being distributed by American Agile Corporation. They are essentially small cylinders charged with air to give them added buoyancy and cover the exposed surface with a layer 1½ inches thick. *Circle 19E on reply card*

In addition to describing the principles of air-gauging with the column Precisionaire in Catalogue No. IPC-6-56, The Sheffield Corporation deals with basic tooling for inspecting internal and external dimensions and conditions as well as with types and sizes of adjustable air-gauge tooling. Many single- and multidimension gauge applications are illustrated. *Circle 20E on reply card*

Ingersoll-Rand Company is offering Form 5189, a flyer describing in detail its new Size "41" Frame Scraper Hoist—a heavy-duty, extra-powerful type designed to handle single-line rope pulls up to 9900 pounds. The unit combines rugged construction with features recommended by master mechanics and maintenance men, namely: reversible buttress-type clutch stops, 3-piece linked



"TORSION BAR" TORQUE CONTROL

Multiple Torque Settings

Size 5040T

—Maximum Torque—90 ft. lbs.

Size 5340T

—Maximum Torque—550 ft. lbs.

15,000

¾" bolts uniformly tightened to 60 ft. lbs.

TORSION BAR

with new Ingersoll-Rand

Torque Control IMPACTOOL

PROBLEM:

Assembly of 1390 mechanical pipe joints involved over 15,000 ¾" bolts. The problem was to speed assembly, remove guesswork and assure proper tightness of all joints.

AIR ENGINEERING SOLUTION:

A new Ingersoll-Rand Size 5040T Torsion Bar Torque Control Impactool, preset to deliver 60 ft. lbs., was put on the job.

RESULT:

The Torque Control Impactool automatically shut off at the preset Torque . . . all guesswork was eliminated . . . uniform joint tightness was produced . . . an average of 10 minutes per joint was saved . . . smaller bell holes were required due to compact size of the 5040T . . . this one tool produced an extra profit of \$404.25 on this job.

You can put these new "Torsion Bar" Torque Control Impactools on your nut running jobs and reap these benefits: Positive Torque Control . . . Simple Torque Setting . . . Setting remains constant . . . No pressure regulators needed . . . No operator training. Write or phone for a free demonstration of this revolutionary fastening development.

Ingersoll-Rand

11 Broadway, New York 4, N.Y.

B-344

Circle 18A on reply card

GET THE JOB DONE

Faster . . . at Lower Cost



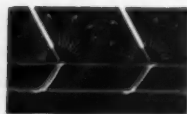
Air lines, water lines, dredging lines or vent lines — wherever there's a job for pipe, you'll be time and money ahead with dependable Naylor Spiralweld.

Because it is light in weight, this distinctive pipe is easier to handle and install. You don't have to "baby" it because Naylor pipe is stronger and safer due to the exclusive lock-seamed, spiralwelded structure.

Installation is further simplified and costs reduced when you use the one-piece Naylor Wedge-Lock coupling to connect Naylor lines.

Get the facts today on this proved, practical way to speed up pipe line operations in construction service. Ask for Bulletin No. 507.

NAYLOR PIPE



Naylor Pipe Company • 1245 East 92nd Street, Chicago 19, Illinois
 Eastern U.S. and Foreign Sales Office: 350 Madison Avenue, New York 17, New York

Circle 19.4 on reply card

clutch band, angled clutch handle extension and motor with NEMA standard Type D flange mountings. Planetary geared primary reduction is said to insure well-balanced drive, and brakes are of the spring-loaded, self-energizing band type. The "41" is of the exclusive Ingersoll-Rand "Unit Assembly" design—that is, each has its own barrel-type housing, rope drum, gearing and independent clutch. It is available in single, double- and triple-drum sets and with air-electric remote control equipment or air-operated clutch.

Circle 21E on reply card

Open-type retaining rings for shafts measuring 1/25 to 1 inch, internal types for housings 1/4 to 2 1/2 inches in diameter (conforming to NAS 50) and external rings to fit shafts from 1/4 to 2 1/4 inches (conforming to NAS 51) are listed in a recent catalogue issued by the Industrial Retaining Ring Company.

Circle 22E on reply card

Allis-Chalmers Manufacturing Company has released a bulletin (No. 53B8424) covering direct-current motors of 1/2 through 200 hp and motor-generator sets up through 200 kw. The bulletin describes shunt- and stabilized shunt-wound, compound-wound and series-wound motors in eight different closures.

Circle 23E on reply card

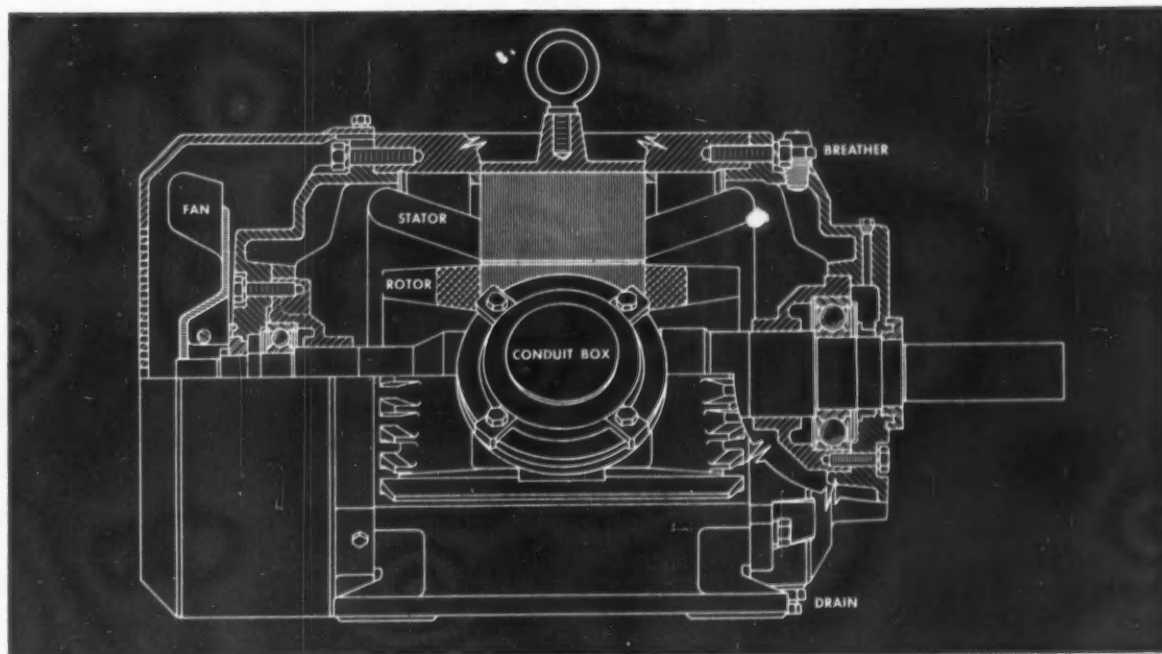
Basic Blading is the title of a 32-page manual for motor graders—for those new at the work and as a refresher course for experienced men. Each phase of the operations from use of the controls to blade positions and their applications is described in understandable language and graphically illustrated. The booklet—Form DE628—is published by Caterpillar Tractor Company also in Spanish, French and Portuguese.

Circle 24E on reply card

Instruments for furnace and oven control in metal processing are the subject matter of condensed catalogue and price list B43-1 issued by Minneapolis-Honeywell Regulator Company, Wayne and Windrim Avenues, Philadelphia 44, Pa. In addition to introducing its new Electronic special Class 14 line of strip-chart, circular-chart and circular-scale instruments, it deals with vane-type millivoltmeter controllers, thermocouples, radiation detectors, flame-failure safeguards, electric and pneumatic valves and other devices.

In a 60-page copiously illustrated catalogue The Cyril Bath Company, Solon, Ohio, gives detailed information about its newly developed radial-draw forming machines that will handle automobile trim or work weighing 300 or more tons. Parts are made by stretching the metal and by applying traveling pressure radially tangential to the shape so that sections up to 360° or beyond can be produced of aluminum, titanium, stainless steel and other materials for aircraft, jet-engine and automotive industries. Catalogue can be obtained by writing to the company.

Comprehensive application and other data on radial roller bearings are contained in a new catalogue and engineering manual prepared by Rollway Bearing Company, Inc., 541 Seymour Street, Syracuse, N.Y. Of 56 pages, it includes for the first time recently computed thrust capacities for its complete line of precision radial roller bearings that obviate the need of computing the equivalent radial load. In addition, the formula of the Roller Bearing Engineers' Committee has been converted into a simple nomograph chart that eliminates complicated procedures in selecting bearings. Request for a copy should be written on company letterhead.



THIS MOTOR CAN CUT YOUR HAZARDOUS ATMOSPHERE INSURANCE COST

Insuring facilities with electric motors in hazardous atmospheres is generally expensive or impossible without special motors. Reliance has developed a completely new, Underwriters' approved motor design, called explosion-proof, for hazardous locations. In fact this is the only motor design that meets all qualifications for class I, group D and class II, groups E, F and G without requiring modification.

This new motor incorporates all of the outstanding features of the standard Reliance Totally-Protected Motor. In addition, all Reliance Explosion-Proof Motors are built to corrosion-proof standards.

If you would like to have more information on what qualifies a motor for hazardous atmospheres, write for our new Explosion-Proof Motor Bulletin No. B-2409.

B-1805

NATIONAL ELECTRICAL CODE CLASSES OF HAZARDOUS LOCATIONS

CLASS I—Those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

Group D—Atmospheres containing gasoline, hexane, naphtha, benzene, butane, propane, alcohols, acetone, benzol, lacquer solvent vapors, or natural gas.

CLASS II—Those which are hazardous because of the presence of combustible dust.

Group E—Atmospheres containing dust of aluminum, magnesium, or their commercial alloys.

Group F—Atmospheres containing carbon black, coal or coke dust.

Group G—Atmospheres containing flour, starch or grain dust.

RELIANCE
Totally-Protected
MOTORS

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 711A CLEVELAND 10, OHIO • CANADIAN DIVISION: WELLAND, ONTARIO

Sales Offices and Distributors in Principal Cities

**SPECIFICALLY ENGINEERED...
NEVER MERELY ADAPTED...
FOR EACH PARTICULAR
TYPE OF APPLICATION**

HANSEN

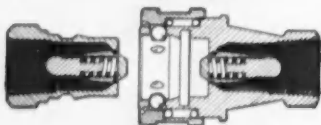
QUICK-CONNECTIVE COUPLINGS



ONE-WAY SHUT-OFF

Shuts off one side of line

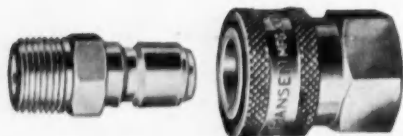
Gives quick connection and disconnection, with instant automatic flow or shut-off. To connect Coupling and open line to flow of fluid, merely push Plug into Socket. To disconnect, a slight pull on sleeve releases Plug and shuts off supply end of line.



TWO-WAY SHUT-OFF

Shuts off both sides of line

To connect, pull back sleeve and push Plug into Socket. Identical torpedo type valves permit free flow of gas or liquid through Coupling. To disconnect, pull back sleeve . . . Coupling immediately disconnects, valves automatically seal both ends of line. Female pipe thread connections from $\frac{1}{8}$ " to 1". Available in brass or steel.



STRAIGHT-THROUGH COUPLING

Provides quick connection and disconnection, but does not have shut-off feature. Sizes, ranging from $\frac{1}{4}$ " to $2\frac{1}{2}$ ", carried in stock. Two special types of straight-through steam Couplings also available—one for low pressures, and one for high pressures.

Quick-Connective Fluid Line Couplings for
AIR • OIL • GREASE • HYDRAULIC FLUIDS
REFRIGERANTS • VACUUM • STEAM • OXYGEN
ACETYLENE • GASOLINE • COOLANTS • WATER
Write for Catalog

**HOSE CLAMPS • HOSE CLAMP PLUGS
HOSE CLAMP SOCKETS • HOSE CLAMP COUPLINGS**

SINCE 1915



Representatives in Principal Cities

QUICK-CONNECTIVE FLUID LINE COUPLINGS

THE HANSEN

MANUFACTURING COMPANY

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CLEVELAND 11, OHIO

Adjustable-speed Gýrol Fluid Drive

controls the flow in catalytic reforming processes

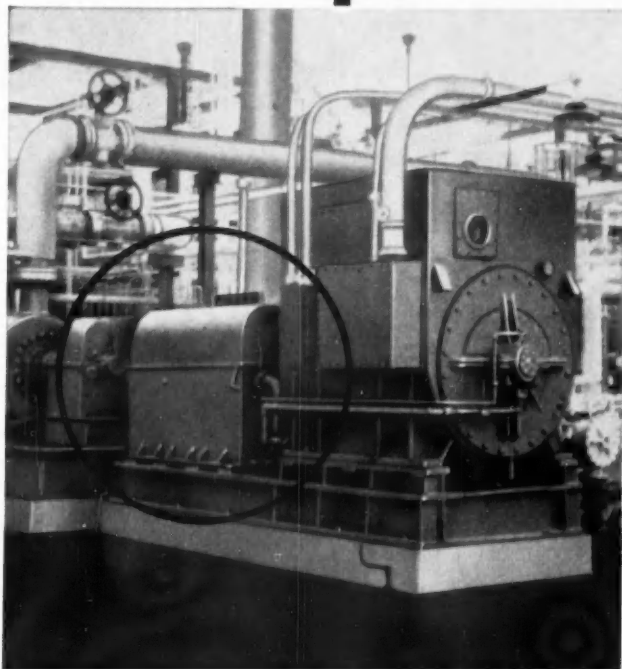


Photo courtesy Union Oil Co. of California

Unit shown is a 4000 hp, 1800 rpm, size 315, type VS, Class-6 Gýrol Fluid Drive equipped to automatically regulate the speed of a centrifugal compressor handling variable-density gases.

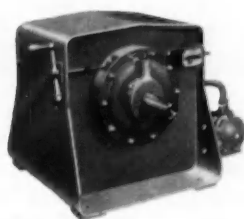
Accurate control of the flow of gases and fluids is the key to the successful operation of a catalytic reforming plant. Because its speed is *adjustable*, American Blower Gýrol Fluid Drives can vary the flow rates of compressors and pumps of all sizes and types — *as needed*. Consider these inherent advantages of Gýrol Fluid Drive:

- Provides infinite and accurate pump speed adjustment over a wide range
- Simplifies starting equipment — provides no-load starting
- Eliminates problem of "gumming" which may occur with mechanical dampering
- Saves steam needed for process work through use of squirrel-cage, constant-speed electric motor
- Permits automatic control. Flow rates can be automatically regulated by simple movement of one push-pull control rod

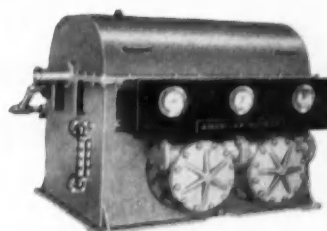
Whatever your method of catalytic reforming, use Gýrol Fluid Drives for flow-rate control. Call your nearest American Blower Branch Office for data.

Traction-type Fluid Drives

American Blower Type TM, traction-type fluid drives are also available as complete packaged units containing AC motor and built-in Gýrol Fluid Drive. Standard NEMA mounting bolt hole dimensions, 1 to 20 h.p.



Type VS, Class-2, adjustable-speed Gýrol Fluid Drive for industrial applications. Sizes, 1 to 800 hp; speeds to 3600 rpm.



Type VS, Class-6, Gýrol Fluid Drive. Adjustable-speed drive for compressors, pumps, and other high-speed applications. 100 to 12,000 hp; to 3600 rpm.

American Blower products serve the petroleum industry

- Air Conditioning, Heating, Ventilating Equipment
- Mechanical Draft Equipment
- Industrial Fans and Blowers
- Centrifugal Compressors
- Gýrol Fluid Drives

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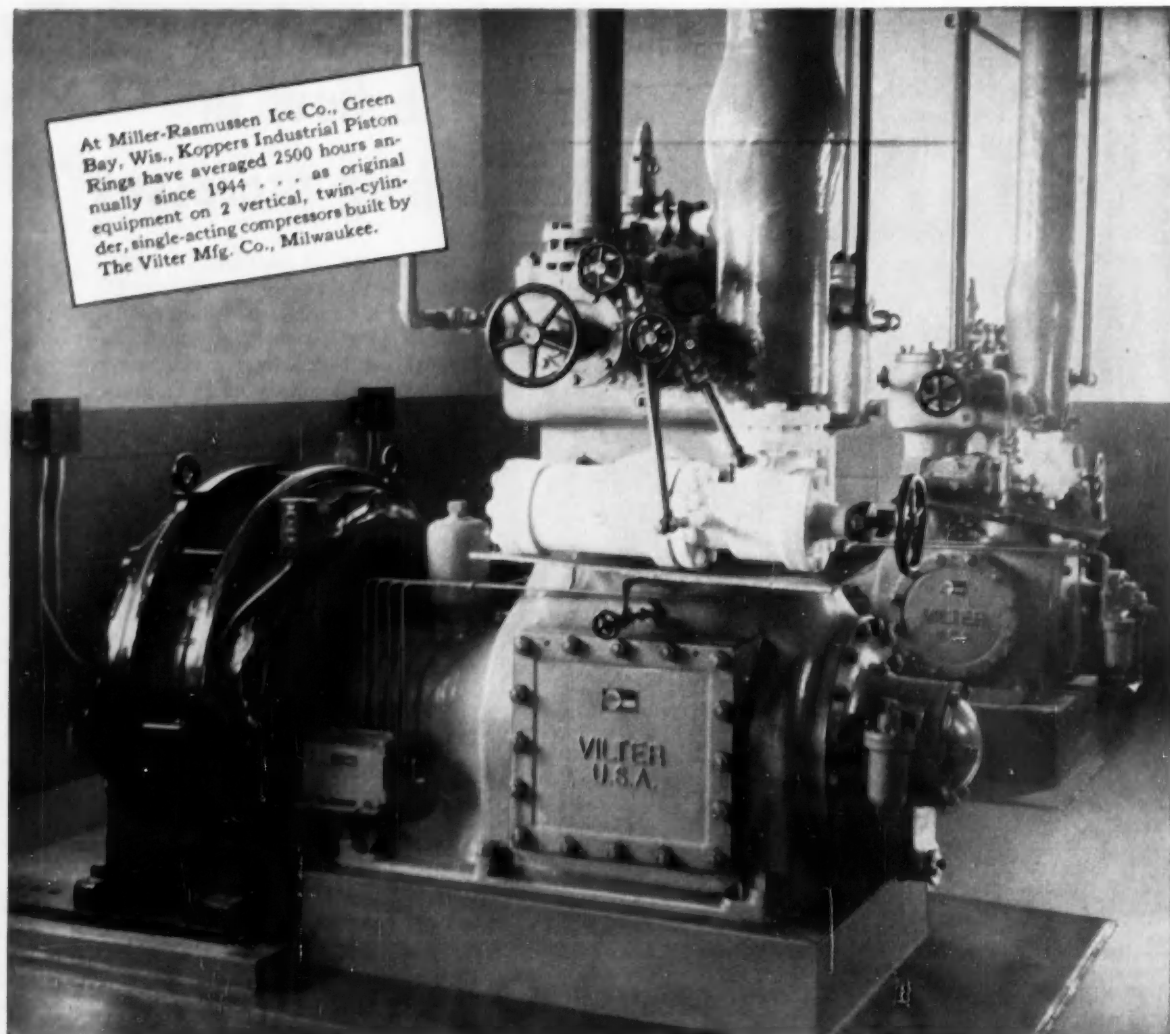
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BLOWER

At Miller-Rasmussen Ice Co., Green Bay, Wis., Koppers Industrial Piston Rings have averaged 2500 hours annually since 1944 . . . as original equipment on 2 vertical, twin-cylinder, single-acting compressors built by The Vilter Mfg. Co., Milwaukee.



Koppers Piston Rings go 10 years without repair, replacement or oil waste!

Like Miller-Rasmussen Ice Co., you can reduce maintenance costs and time and increase operating efficiency with Koppers Industrial Piston Rings. You can profit from longer piston ring life . . . longer cylinder life . . . and eliminate piston ring feather, scoring and scuffing.

Koppers American Hammered Industrial Piston Rings prolong the lives of Diesel, gas, aircraft, gasoline and many other engines, valves and compressors. Rings range in diameter from 1 inch to 10 feet . . . are of cast iron and special alloy cast irons;

they may be chromium-plated for added durability.

Our field engineers in your area will be glad to unravel your knottiest piston ring problems and help provide you with a new high in piston ring performance. They'll check your present piston rings in operation . . . recommend the proper ring type . . . or even have a ring designed for your specific application.

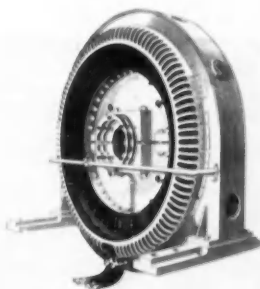
Bring your piston ring problems to Koppers. Phone or write: KOPPERS COMPANY, INC., *Piston Ring and Seal Dept.*, 611 Scott St., Balto. 3, Md.

Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.
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AMERICAN HAMMERED
Industrial Piston Rings

**HOW GENERAL ELECTRIC SYNCHRONOUS MOTORS
REDUCE MAINTENANCE COSTS**



AFTER WINDING OPERATION, NEW POLYEX COILS WILL BE VARNISHED TO SEAL OUT MOISTURE AND CORROSIVE OR ABRASIVE MATERIALS

New Polyex* coils increase motor life

Polyex insulated coils, a recent General Electric development, will greatly increase the life expectancy of large motors and substantially reduce maintenance requirements. Prior to being introduced into the manufacture of G-E motors, Polyex coils were subjected to numerous exacting tests to prove insulation characteristics. These tests showed that Polyex coils have many times the physical strength of conventional coils. Throughout the tests Polyex insulation retained its superior characteristics—even after being baked for thousands of hours at 125 C.

Twice the resistance of other coils to operating temperature changes, moisture, contamination and mechanical damage is possible because Polyex coils are insulated with polyester films and fibres which

are treated with the newest hydrocarbon resins. This all-dielectric insulating system is possible because the latest technological developments of chemistry and engineering are combined with the practical skills of more than a half century of coil manufacture.

Polyex insulated coils are but the most recent development in General Electric's continuing efforts to provide a maximum in motor life and reduce motor maintenance to a minimum. For more information about General Electric motors, contact your Apparatus Sales Office. A sales engineer will be glad to explain the many other advantages of G-E low-speed synchronous motors. Write for Bulletin GEA-5332. Address Section 775-6, General Electric Company, Schenectady 5, New York.

*Reg. Trade-mark of General Electric Co.

GENERAL  ELECTRIC

NOW..
GREATER THAN EVER
PROTECTION
TO YOUR AIR LINE
with the outstanding



**WHIRL-A-WAY FILTER, REGULATOR
AND LUBRICATOR ASSEMBLY
and AUTOMATIC
AIR TRAP**

MODEL W-4



**↓ AIR TRAP
EJECTS WATER
AUTOMATICALLY
AND RAPIDLY**

The **FILTER** removes solids .00039 and larger. Transparent bowl provides visibility. The **REGULATOR** can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact. Machined from bar aluminum.

The **LUBRICATOR** delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The **AIR TRAP** is an Automatic Water Ejector for all air line applications. Assures dry air in pneumatic systems at all times. Eliminates costly downtime and assures preventive maintenance. **WRITE FOR LITERATURE.**

M-B PRODUCTS
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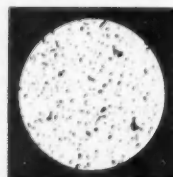


**Having Bearing Troubles
Due to Poor Lubrication?**

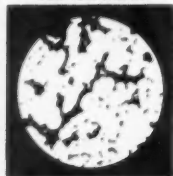
**...then BEARIUM METAL
is the Answer to Your Problem!**

Even where water must be used as the only lubricant... **BEARIUM METAL** does not and will not seize or score the shaft. The reason is that **BEARIUM METAL**, because of its superior frictional properties, is self-lubricating. Secret of its amazing performance is due to the uniform distribution of microscopic lead particles within the copper-tin grains rather than between the grain boundaries as found in ordinary bronzes.

So, if you have a bearing requirement which calls for dependable, trouble-free performance—then by all means—**BEARIUM METAL** is your best buy in bearing bronze. Try it on one of your toughest applications and prove it to your own satisfaction.



Bearium Metal



Ordinary Leaded Bronze

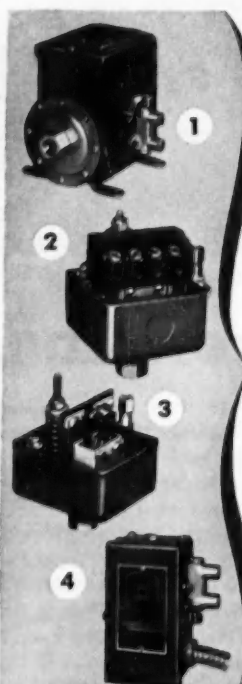
Complete Information on Request.

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**FOR A
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SWITCHES**

- ① Heavy Duty
 - ② Standard Duty
 - ③ Gas Engine Cut-Out
 - ④ Magnetic Unloader
- full range of electrical and pressure ratings

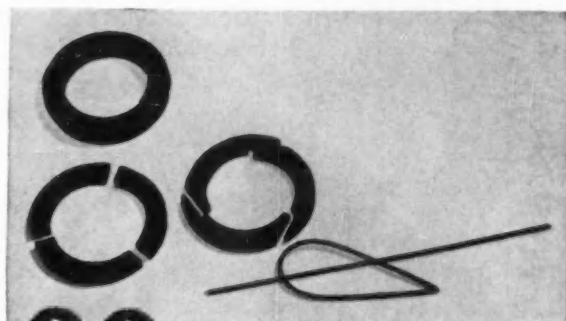
Write for Bulletin 550,
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Richards St., Milwaukee 12, Wis.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS



SQUARE D COMPANY

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Look to **COOK** for Better **PACKING RINGS!**

Whatever your packing-ring requirements, you can depend on Cook for a ring *design* and ring *material* that will deliver maximum efficiency at minimum cost.

One *source*, one high standard of *quality*—that's what you get when you specify Cook—packing-ring pioneers since 1888. Write direct for complete technical data. C. Lee Cook Company, 930 So. 8th St., Louisville 8, Ky.

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(Exclusive with Cook)
COOKMET
(No. 1—Plastic Bronze)
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(No. 3—Alloy Bronze)

BABBITT
(Highly Anti-Frictional)

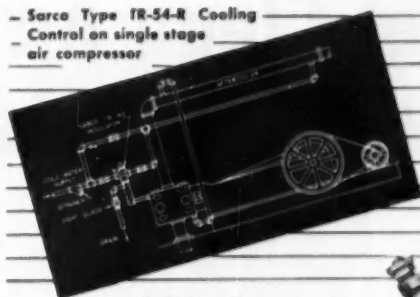
COOKROC
(Laminated Bakelite; Standard, Hi-Temp and Graphitized)

CARBON
(For Non-Lubricated Service)

**C. LEE
COOK
COMPANY**
Sealing Pressures Since 1888

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— Sarco Type TR-54-R Cooling
— Control on single stage
air compressor



efficient COMPRESSOR COOLING

- Do you want to avoid over — or under — cooling?
- Do you want to save cooling water and lubricants?
- Do you want to increase the efficiency and life of your air compressor? ... then install SARCO COOLING CONTROLS

Simple • Self-operated • Inexpensive

Ask for Bulletin No. 701

SARCO COMPANY, INC.

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SARCO CANADA LTD., TORONTO 8, ONTARIO



Sarco
TR-54-R

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THE TOOL-OM-ETER

Compressed Air Meter shows direct on a scale, in cubic feet of free air per minute, the flow of air in a pipe or hose. These meters will show the air consumption of any pneumatic tool, rock drill, air motor, sand blast, air-lift, or other application of compressed air.

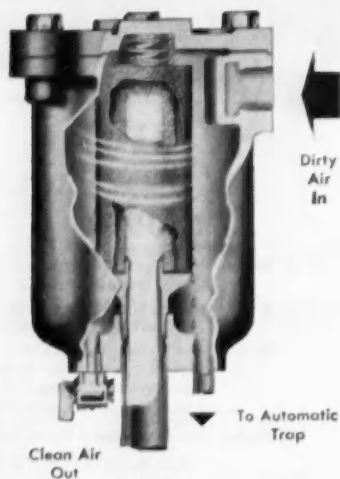
They are also used for maintaining air equipment in most effective working condition. You can get the facts about your use of compressed air, and these facts will enable you to bring your costs and production under profitable control. Write for new Bulletin A-8.

WE SPECIALIZE in compressed air devices, including the "DriAir" Separator for automatically removing the water from compressed air lines. Ask for Bulletin DA.

New Jersey Meter Co.
Plainfield, N. J.



Get Clean Air for Your Tools



Adams Poro-Stone Air Filters **SAVE MONEY·TIME**

You get protection that counts with Adams Poro-Stone Air Filters. Damaging water, rust contaminated oil, dust and pipe scale are removed from your compressed air . . . and there's virtually no pressure drop across the Adams filter.

Separation of foreign matter is in two stages—by centrifugal action from the movement of the air itself . . . by diffusion through the permanent Poro-Stone filter tube.

Not only do you save money in longer tool life and trouble-free operation, but also you save time. That's because Adams filters are quick to clean . . . have no moving parts to wear . . . need no special tools . . . proper assembly is all but fool-proof.

For full details and prices, write today for your copy of New Bulletin 117.

R. P. ADAMS CO., INC.

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R. P. ADAMS COMPANY, INC.

209 EAST PARK DRIVE
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N-56

Please rush me your New Bulletin 117 with sizes and prices.

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Adv. 28



Wherever There's Hose . . . You'll Find **PUNCH-LOK HOSE CLAMPS**

Why so popular? They're today's best bet! Punch-Lok clamps last for the life of the hose. There are handy clamping tools for putting them on with the precise tension desired. It takes only seconds to do the job. No wear. No tear. No leak. No snag. Used in industry—everywhere.

Write for Descriptive Literature
or See Your Nearby **PUNCH-LOK** Distributor



"The Sign of a GOOD Hose Clamp"

PUNCH-LOK
Company

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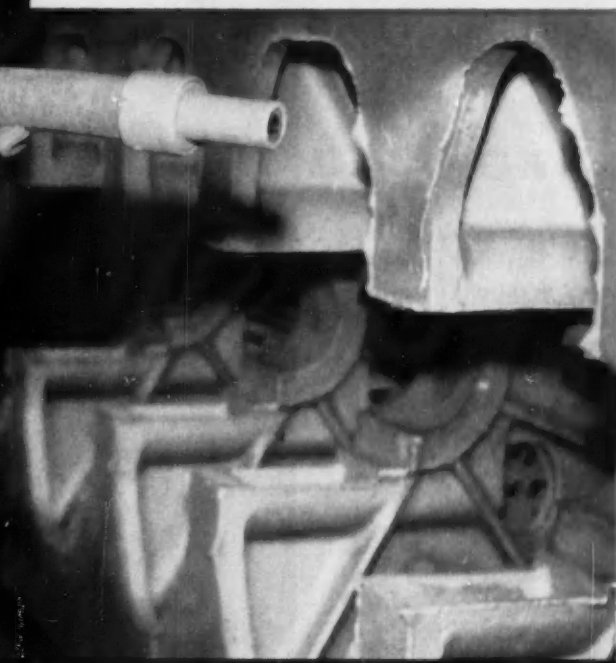
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COMPRESSED AIR MAGAZINE



BLAST!

BIG ones like this



or small ones, too!



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BORON CARBIDE

NORTON PRODUCTS: Abrasives • Grinding Wheels
Grinding Machines • Refractories
BEHR-MANNING PRODUCTS: Coated Abrasives
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... More Economically with **Norbide® Pressure Blast Nozzles**

THERE'S a NORBIDE Nozzle available to give you exactly the type of cleaning stream you need — from a broad stream for large areas to a pencil-thin stream for cleaning small openings. And NORBIDE Nozzles — lined with the hardest manufactured material commercially available — maintain stream contour, last longer than any other nozzle made and deliver maximum blasting efficiency at minimum cost per hour.

For full details on cost-cutting NORBIDE Nozzles, write for your free copy of Form 543.

NORTON COMPANY
41 New Bond St., Worcester 6, Mass.

NORBIDE® . . . The Longest Nozzle Life You Can Buy

HOW



REFINERY PUMPS

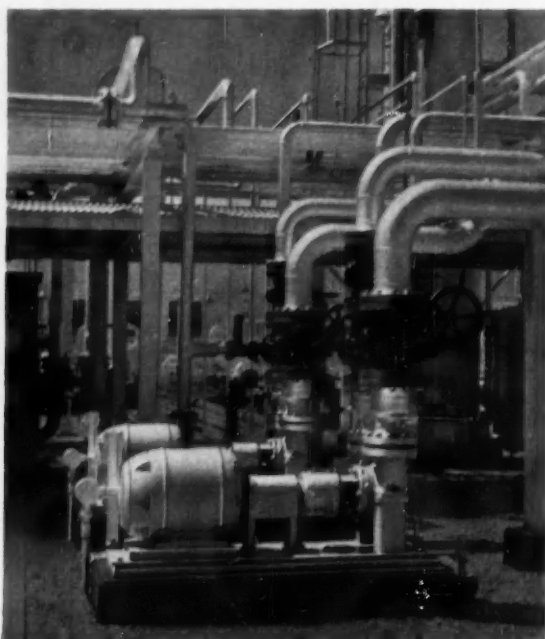
CUT DOWN-TIME • SAVE MAINTENANCE

Easy maintenance and less of it. These are important considerations in the design of every Ingersoll-Rand Refinery Pump. Here are some of the features that keep these pumps *on the job* longer, cut down-time and save maintenance costs.

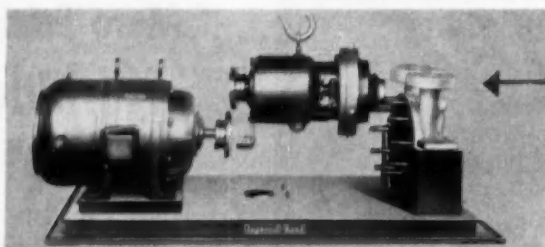
IMPELLER is carefully balanced for freedom from vibration. Made of bronze, iron or steel, for maximum service life under operating conditions. Impeller attached to shaft with pin-locked cap screw—can't work loose.

CASING is heavy-walled to provide corrosion allowance with conservative safety factor at maximum working pressure. Centerline support and water cooled stuffing box for hot liquid service to 800°F.

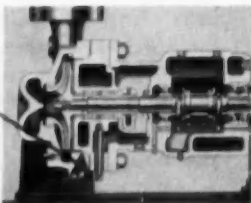
CASING LOCATING PIN, centered under casing, assures perfect pump alignment during high-temperature operation.



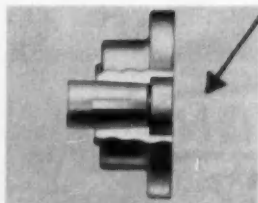
Two 1 1/2" SFL pumps on reflux service at a natural gasoline plant.



Class SFL pump with coupling spacer removed, showing ease of disassembling pump unit.



Cross section of SFL pump



Ground, tapered coupling fit

SHAFT, of heat-treated carbon steel or stainless-steel, is fully ground and polished—held to close tolerances over entire length for perfect fit of replacement parts.

STUFFING BOX is deep enough to allow packing to be arranged to suit the application. Holds 8-10 rings, packed solid. Mechanical Shaft Seals can also be supplied.

SPLIT-TYPE GLAND is easy to remove from shaft. Smothering liquid can be circulated through gland when hazardous liquids are handled.

SPACER COUPLING permits quick, easy removal of entire pumping assembly without disturbing piping or driver.

TAPERED COUPLING FIT, with key and lock nut, eliminates need for shrink fit and permits easy removal or replacement.

For the complete story on I-R refinery and process pumps, send for your copy of Bulletin 7094B.

Ingersoll-Rand

10-417

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Built to Your Specifications



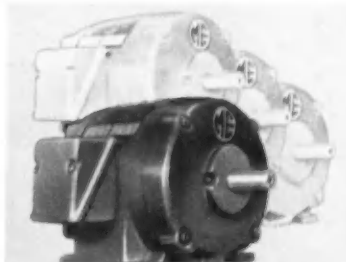
Nationwide Service

A Service Station and District Office is near you



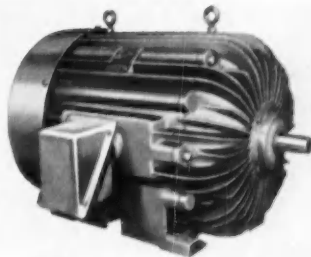
FRACTIONAL H.P. MOTORS

General Purpose:
1/20 HP up From Stock
Special Purpose:
Built to YOUR Specifications



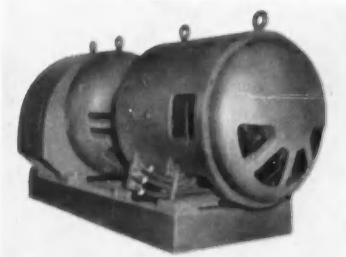
NEW NEMA INTEGRAL HP MOTORS

Provide 4 in 1 Protection:
Drip-proof . . . Splash-proof
Weather Protected . . . Guarded.
All at Open Motor Prices



TOTALLY ENCLOSED FAN-COOLED MOTORS

Ribbed Frame Construction:
Cool, Clean, Efficient
Explosion Proof Ratings to 250 HP
Carry This Label



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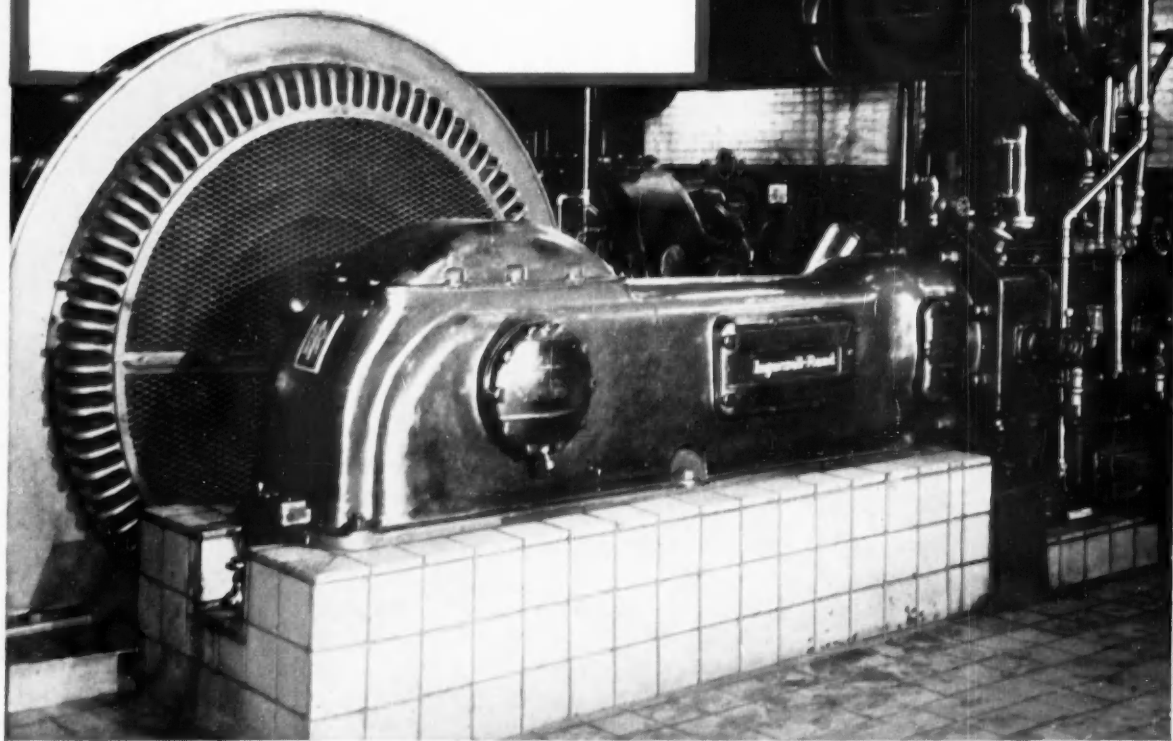
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